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THE ANTS OF NORTH AMERICA

BY WILLIAM STEEL CREIGHTON

WITH FIFTY-SEVEN PLATES

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The Ants of North America

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INTRODUCTION

During the years that the writer spent on the preparation of this volume its character changed completely from what was originally intended. When Dr. W. M. Wheeler proposed, in the fall of 1936, that we collaborate on a field book of North American ants, his idea was to prepare a keyed catalogue similar to that which Emery published on the ants of Italy in 1916. No revisionary work was contemplated and the publication was to include keys and distributional data which would aid in field studies of our ants. This seemed an excellent idea, for many summers spent collecting ants in all parts of the United States had convinced me of the need for a single, concise volume which could be carried into the field. I gladly acceded to Dr. Wheeler's proposal and began work on the book. Dr. Wheeler's death occurred in the following spring, before he had made any active contribution to the volume. This left its preparation entirely in my hands. As I worked over the material in the Wheeler Collection, the need for revision became apparent. At that time current concepts relating to speciation were beginning to take shape and there seemed to be abundant opportunity to apply these concepts to ant taxonomy. With this in mind I undertook not only to prepare the necessary keys and to collate the vast amount of distributional data in the Wheeler Collection, but also to revise the two infraspecific categories employed in ant taxonomy.

The complexities of ant nomenclature have been considered in the section which follows this introduction. They need not be discussed here, but it seems advisable to state that, as a result of the revisionary work presented in this volume, it has been necessary to treat a large number of forms as synonyms. In 1947 Dr. M. R. Smith listed 742 species, subspecies and varieties of ants which have been taken in the United States. In the present work only 585 of these are recognized as valid taxonomic entities. Despite this reduction, the number of species has been increased, for it has been necessary to accord full specific status to many forms previously regarded as subspecies. Moreover, there has been surprisingly little need to synonymize previously recognized species. Hence, the great majority of the 157 forms which have gone into the synonymy have been subspecies or varieties. The end result has been to eliminate the variety as an infraspecific rank. For all the varieties which have been retained as valid show the characteristics of geographical races and have, for this reason, been given subspecific rank.

In the case of some species which originally possessed a large number of subspecies and varieties, revision has radically altered the character

of the assemblage. Under such circumstances it has seemed advisable to present a single account of the changes involved. This discussion is placed immediately after the name of the species but ahead of the bibliographic citations and other data relating to it. Although this represents a departure from the customary treatment, it is believed that the method will be of substantial aid to the reader. It permits a comprehensive view of the revision within the species. It also avoids repetition, since the same revisionary considerations can often be applied to several of the variants simultaneously.

The bibliographic citations carried for each species and subspecies have been extensively edited. It is no longer practical to present full bibliographies for many of our species. In recent years many regional studies dealing with the distribution of our ants have been published. Much use has been made of such studies in preparing the ranges presented herein. But I cannot feel that this type of publication should be listed in the bibliography of each species which it covers. It has been assumed that if the reader of this book finds it necessary to look up references given under the various species, it will be because he wishes to secure a fuller knowledge of the structure of the insects than can be obtained from the keys. Considerable effort has been made to see that all such references apply to descriptive material or to points which elucidate the taxonomy of the species involved. Papers which carry only distributional records have been placed in the general bibliography at the end of the volume.

Since much stress has been placed on the importance of distribution in this work, I wished to present the ranges of the species and subspecies in a way which would be both accurate and concise. After considerable experimentation with various methods I doubt that there is any entirely satisfactory way by which this can be done. If all known records are cited the result is an accurate but clumsy list,which requires analysis by the reader before it conveys any impression of the range. At the other extreme are those over-simplified statements which announce that a species occurs in the northeastern United States or in Sonoran areas of the southwest. Such statements leave nothing to be desired as far as brevity is concerned, but they are as vague as the first method is cumbersome. The plan followed in this volume represents a compromise between these extremes. I believe that it is accurate enough to give the reader a satisfactory picture of the range without overwhelming him with a mass of details.

Another point related to distribution involves the question as to whether the territory covered in this book warrants the title chosen for it. I make no excuse for the title employed, or for the fact that I have excluded those species in Mexico and Central America which

do not enter the United States. A political boundary is rarely a biological terminus. As far as ants are concerned North America has no southern limit. In extreme cases the range of a species may extend from the central United States to northern Argentina. Hence for practical purposes one may as well select the political boundary which most closely approximates the natural boundaries of major faunistic groups. From this standpoint the northern border of Mexico serves best. Our extensive Nearctic ant fauna is largely confined to regions north of Mexico and the few representatives of this fauna which occur in Mexico are strictly limited to the higher mountain ranges. The reverse situation applies to the tropical element of the Mexican ant fauna. A number of genera and subgenera commonly encountered in Mexico and Central America have no representatives in the United States. In other cases Neotropical genera possess only one or two species which enter the United States, and these species rarely range more than a few miles north of the Mexican border. The large Sonoran component of our ant fauna is equally abundant on either side of the border. But portions of this fauna extend throughout much of South America, hence it must be given an arbitrary southern limit in any case.

Unless otherwise noted all keys in this volume apply to the worker caste. The important part played by this caste in ant taxonomy is often misunderstood by those who contend that sound specific distinction must rest upon the characteristics of the sexual forms. There is no objection to this view, but there are practical considerations which limit its application to ant taxonomy. For very obvious reasons the worker caste is far more likely to come into the hands of the collector. In most ant colonies the sexual forms leave the nest soon after they have reached the adult condition. Because of this, the period during which all three castes can be taken together is, ordinarily, a very limited one. Moreover it is often impossible to secure the queen when a nest is discovered. At the slightest disturbance to the nest the queen will hide herself in its most obscure part and extensive excavation may fail to exhume her. These circumstances have greatly reduced the number of males and females taken in association with workers. As an example, there are sixty-three species and subspecies of Pheidole included in this volume. The worker caste of all of these has been described. But the female caste has been described in only twenty-six cases and the male caste in no more than eighteen cases. This proportion represents a reasonable approximation to what is found in most of the larger genera. Until a higher percentage of females and males can be associated with the workers it is not advisable to present keys for the identification of the sexual forms.

The introduction to this volume would not be complete without

reference to the individuals and groups who contributed in various ways to its production. Of these the late Dr. W. M. Wheeler stands first. The writer not only benefited from a personal association with Dr. Wheeler but also from his generosity in the gift of a large number of identified specimens which he and others had described. Other myrmecologists who have generously contributed material are Dr. M. R. Smith, Dr. C. H. Kennedy, Dr. A. C. Cole, Dr. G. C. Wheeler, Dr. L. G. Wesson, Mr. W. F. Buren, Mr. W. L. Brown, Jr. and Mr. G. S. Walley. Without these specimens the work would have been seriously hampered.

A very important contribution was made by the American Philosophical Society, which provided a grant to cover the preparation of the illustrations. With this grant the services of Mrs. Shirley Risser were secured, and it is due to her care and skill that the illustrations of this volume were produced. I am indebted to the Board of Higher Education of the City of New York for granting me leave during which most of the work on this book was done. I also wish to thank Harvard University for a research fellowship during 1938 and the Museum of Comparative Zoölogy for providing research facilities and for allowing me access to the Wheeler Collection. Thanks are due to the American Museum of Natural History for similar privileges. I wish to thank the Wheeler family for permission to examine Dr. Wheeler's unpublished manuscripts.

The arduous task of proof-reading the original type-script was undertaken by Mr. W. L. Brown, Jr. His care and thoroughness have eliminated many minor errors which might have entered the volume. I wish to express my sincere appreciation to Mr. Brown for this valuable assistance.

In conclusion, I venture to hope that, despite its revisionary character, this volume may fulfill the purpose for which it was originally intended. By his unsparing efforts Dr. W. M. Wheeler built up a superb collection of North American ants and produced a large body of literature dealing with them. Both must be constantly consulted by anyone who hopes to do significant taxonomic work with our species. But Dr. Wheeler was aware that work in a library or a museum is only a part of the taxonomic picture. He never lost sight of the importance of field work and it was his wish to arrange matters so that such work could be done accurately and without constant recourse to type specimens and original descriptions. If subsequent events show that field work on our North American ants can be done with more ease and accuracy because of this book, I will feel that it has fulfilled Dr. Wheeler's wish and that I have been amply repaid for the time and effort spent on its preparation.

THE PRESENT STATUS OF ANT TAXONOMY AND NOMENCLATURE

The myrmecologist may count himself fortunate that he has to deal with a group in which specific characteristics are so clearly and easily discernible. Most ant colonies are composed of the offspring of a single female. This female usually mates but once and at that time she receives from the male the entire supply of spermatozoa which will subsequently fertilize her eggs. These sperm cells are all genetically identical, since the male ant is haploid and produces spermatozoa directly, without meiosis. The relationship of the workers produced by such a female is, therefore, a peculiar one. As Dr. George Snell has pointed out, they are not only sisters but half-identical sisters. From the standpoint of their genetic constitution there is every reason to believe that in those ant colonies which possess a single queen, the workers should show a much greater uniformity of structure than would be found in a population where both parents are diploid and where repeated insemination from random mating occurs. The hereditary constitution of the worker caste in most ant colonies is as rigidly controlled as that of animals experimentally bred in a genetics laboratory. It is not sound judgement to apply to the population of an ant colony, the same considerations that would have to be used for a group of individuals selected from the general population of a non-social species. The two groups are not genetically comparable and, because of this difference, the ant colony is far easier for the taxonomist to handle. It may be doubted that many myrmecologists have concerned themselves with the reasons for this fact, but they have been fully aware of the fact itself and have profited greatly by it. When a student of ants observes that certain characters are constant throughout the entire worker population of a colony, he knows that this constancy has not been due to any attempt on his part to select or arrange the population with an eye to uniformity. The personal equation in specific delimitation is thus reduced to a minimum because the myrmecologist is blessed with material which advertises its own specific characters. When these same constant characters are repeated with an equal constancy in colony after colony, the myrmecologist need not be blamed if he feels that his specific criteria are as well founded as it is possible for such things to be.

If the characteristics which occur in an ant colony are so favorable to taxonomic work why has the myrmecologist involved himself and his field in such an altogether horrendous maze of nomenclature? Why not be satisfied with the well-marked species that nature has so obligingly provided and let it go at that? The difficulty arises mainly

from the methods which have been used to handle infraspecific variability. It is not surprising that myrmecologists were among the first to recognize the need for infraspecific categories. About 1875 both Emery and Forel began to give names to units of less than specific rank. By this time the taxonomy of European ants had reached a condition of considerable stability. The mistakes and unavoidable duplication of the early workers had been largely corrected by the efforts of Roger and Mayr, and there was good agreement as to the definitive characteristics of most of the species. Indeed this agreement seems to have been too good. Because the species were so clearly marked, Emery and Forel felt no hesitation in attributing varieties or races to them. As I have attempted to show elsewhere (1938) the initial recognition of infraspecific units seems to have been due to Forel's exhaustive field work in Switzerland. Dr. W. M. Wheeler often expressed the opinion that no other myrmecologist ever studied a region with such thorough attention to detail. At first Forel not only traced the ranges and ecological characteristics of his subspecies but even recognized the existence of intergrades between them. To these he gave hyphenated names indicative of the two parent races. Those who feel that there is a great gulf fixed between modern taxonomy and the older classical brand would do well to remember Forel's *Fourmis de la Suisse*, which was first published three-quarters of a century ago. I do not mean to imply that Forel's treatment of Swiss ants would meet all the requirements which present-day concepts of speciation have laid upon classification. But it certainly cannot be said that the idea of intergrading geographical races is any novelty to ant taxonomy. It is unfortunate that neither Forel nor Emery were able to continue the type of work with which Forel began his myrmecological career. Both men became increasingly absorbed with the study of cabinet specimens from exotic sources. The distributional data which accompanied these expatriated specimens was seldom adequate for geographical analysis. As a result the recognition of a subspecies came to depend less and less on the behavior of the insect in the field and more and more on the structural characteristics which it showed. Even so, ant taxonomy would not have differed greatly from that of many other groups had not Emery begun the practice of subordinating the variety to the subspecies. Emery possessed a phenomenal acuity in dealing with structural variation and an equal ability for intricate organization. No one can claim that Emery's method of dealing with infraspecific variation lacked consistency. The differences on which he based his subspecies were less striking than specific distinctions and more apparent than varietal criteria. But, since the magnitude of the difference was the main consideration, the process was remarkably similar to grading eggs or apples for size.

By current standards Emery's system is unacceptable, but this has not been the main reason for the many objections which have been directed at it. The subordination of the variety to the subspecies has made ant taxonomy so complex that it has become unmanageable. There have been numerous proposals designed to alleviate this situation. I shall speak only of the one which I made in 1938, since the remedy suggested has proven a very poor panacea indeed. I proposed to do away with the varietal rank altogether and treat all infraspecific variants in ants as subspecies. This proposal was based on the belief that most subspecies and varieties would prove to be geographical races when they were better known. If my surmise had been correct the preparation of this book would have been greatly simplified. It is always easier to suggest that a form be elevated to a higher rank than to show why it must be sunk as a synonym. The main difficulty has been with the varietal rank. I now know that I was wrong in supposing that most of our varieties can be treated as geographical races. Amazingly few of them have the distributional characteristics which such races should show. This is particularly true of varieties based upon color. These color varieties almost never possess any distinction of range that would separate them from the 'typical' form. The two occur together over a common range and there is usually a high degree of intergradation between them at all points of this range. I regret to say that numerous color varieties have been set up, although it was recognized at the time of original description that the type series consisted of intergrading material of this sort. In such cases the definitive varietal characters will apply to only a part of the type series. This peculiar situation is certainly irritating, for it shows the low regard in which the variety has been held even by those who elect to name them. The more I have studied color varieties, the more I have been surprised to discover how little justification there is for the recognition of most of them. These varieties possess no distinctive distributional features. There is no constancy in the color characters which are supposed to define them. Their recognition involves practices which are completely at odds with our customary taxonomic procedure. Their naming places a heavy burden on our nomenclature. To arrive at a satisfactory solution for these difficulties it is necessary to recognize that in many species and subspecies of ants no narrow distinction for color can be laid down. Since the color varies we must expand our concept of the 'typical' condition to include all the color phases. In such species there is no justification for distinguishing between the 'typical' coloration and off-colored conditions merely because the type series happened to include only a part of the color range. We must, in short, synonymize many of our color variants

with the 'typical' forms from which they should never have been separated. With this in mind I have relegated more than one hundred varieties to the synonymy in this volume.

In the case of our subspecies the situation is much better. Comparatively few of these have had to be considered as synonyms and in most cases revision has been upward. Most of the larger genera possess at least one 'protean' species to which many subspecies have been assigned. The structural differences which distinguish these subspecies usually consist of relatively minor variations in sculpture, pilosity and proportion which do not depart to any great extent from the structural criteria on which the species has been founded. The magnitude of these subspecific distinctions is usually very similar, hence if structure alone is considered, they would all have to be placed in the same category. On the basis of distributional data, however, they fall into two distinctly different groups. In many cases two or more of these 'subspecies' will occupy an identical range and preserve their distinctive structural features throughout this range without intergradation. Since this behavior is that of a species and not that of a geographical race, such variants show that they are the 'sibling species' with which modern taxonomy has been so vitally concerned. It is necessary to raise this type of subspecies to full specific rank. The subspecies in the second group (and a very few varieties) show the characteristics of geographical races. Each of them occupies a range of its own and maintains its structural identity over that range except in areas of overlap with the range of another subspecies. In these areas of overlap intermediate forms are produced. In this case all that need be done is to raise the varieties to subspecific rank, for this category is the proper one for geographical races.

It seems clear that the arrangement just discussed will more nearly meet with the exacting requirements of modern taxonomy than does our older system. It would also appear that it takes care of most of the problems involved without calling for the use of distinctions which are, at present, subject to speculation. I find little sympathy for much that passes as gospel among the more esoteric disciples of speciation. The taxonomist cannot be expected to evince enthusiasm for species which can only be distinguished by a different rate of wing beat or the structure of the salivary chromosomes. Such matters are, doubtless, of great interest to the theorist who, because of his detachment from the practical side of taxonomy, is free to speculate as he pleases concerning specific criteria. But the taxonomist enjoys no such freedom. Unless he can furnish specific criteria which are reasonably obvious and easy to use, his entire system falls into disrepute. It is plain, therefore, that the taxonomist will continue to pin his

faith on external structure as the major specific criterion. It may be that in the future we shall have to accept ecospecies and psychospecies as valid taxonomic entities, but at present such things seem best left to the theorists.

THE HISTORY OF ANT TAXONOMY IN NORTH AMERICA

To anyone familiar with the excellent history of myrmecology which formed a chapter in Wheeler's volume *Ants* a further discussion of this subject may seem redundant. There are, however, two good reasons for reviewing the matter here. Taxonomy often resembles the law in that opinions may be more important than the facts on which they are based. While it is easy to evaluate facts it is not so easy to judge the worth of an opinion unless one knows something about the individual who has given it. This alone would justify a brief account of the men who have built up the intricate structure of formicid taxonomy. But there is an even more compelling reason in Wheeler's own work. Since he modestly forbore to mention in his book his own unique contribution to the taxonomy of North American ants, it is not amiss to try to show how great that contribution has been.

In the ensuing account I have dealt only with those myrmecologists who have undertaken descriptive taxonomy. This has made necessary the wholesale elimination of many notable specialists whose work has lain outside this rather restricted field. I have further limited this field by dealing primarily with those workers whose studies contributed to the classification of North American ants. This has excluded a number of eminent taxonomists whose contributions have been mainly or entirely based on the ants of other faunal regions. Even with these limitations the subject is far from easy to present since much of the taxonomy of our ants has been done by European specialists and this involves a parallel treatment of events on opposite sides of the Atlantic which can be very confusing.

While the ant fauna of North America contains three Linnaean species, *Monomorium pharaonis*, *Tetramorium caespitum* and *Formica fusca*, it is only indirectly that we can regard the patron saint of the taxonomist as having begun the classification of our ants. For *M. pharaonis* has been introduced here and Linnaeus described it from African specimens, while the other two species occur in Europe as well as in America and the material on which they were based came from the former region. It was a student and compatriot of Linnaeus, the Baron De Geer who made the first description of an ant taken in North America. In 1773 he described a *Formica pennsylvanica*, which we now recognize as the widespread *Camponotus pennsylvanicus*. In

1798 the Danish taxonomist Fabricius described a second ant endemic to North America. His *Formica ferruginea* (*Camponotus pennsylvanicus* subsp. *ferruginea*) is a common and conspicuous insect and it is not surprising that it should have been among the first of our ants to receive recognition. Four years later the talented French myrmecologist Latreille added three more descriptions of North American ants. All three species, *Pogonomyrmex badius*, *Formica pallidefulva* and *Camponotus castaneus*, occur along the eastern Gulf coast and in Florida and it may be assumed that Latreille received some of his specimens from a fellow-countryman in what was then French territory. In 1804 Fabricius described three Neotropical species whose range extends into this country (*Pachycondyla harpax*, *Trachymesopus stigma* and *Solenopsis geminata*) but here, as in the case of Linnaeus' species, the type material did not come from within our borders. With this handful of species as a start the taxonomy of North American ants lapsed into a period of quiescence which was unbroken for more than thirty years.

In 1836 there appeared in the Journal of the Boston Society of Natural History, a posthumous publication of Thomas Say, describing a small collection of ants from Indiana. In view of the scope of Say's studies it is not surprising to find him the first American to publish in the field of ant taxonomy. It was not until the end of his life that Say became interested in ants and his death at the comparatively early age of forty-seven put an end to his myrmecological studies almost as soon as they were begun. Had Say lived to extend his observations the development of ant taxonomy in this country might have taken a very different course. Of the nine ants described by Say five are recognized at present and, since three of these are very abundant species, Say has left us a frequent reminder of the first ant taxonomy done on this side of the Atlantic. In the ten years following Say's publication only two new North American forms were described. One of these, *Labidus esenbecki*, was set up by Westwood in 1842, the other, *Stigmatomma pallipes*, by Haldeman in 1844.

From the foregoing account it may be seen that up to the year 1845 remarkably few of our native ants had been described. The total number appears to have been twenty-three, for to those mentioned above, it is necessary to add the problematical *Lasius exulans* which Fabricius described in 1804. Of these twenty-three species only eighteen, as subsequent events have shown, were sufficiently well described to be recognizable. One may grant that in 1845 most of the western third of North America was virtually unknown and certainly uncollected. But even with this reservation the number of described ants seems pathetically small. I take 1845 as a significant date because it

marks the reawakening of interest in ant taxonomy. This renaissance was primarily a European phenomenon but its effects on the classification of our native ants were very considerable. In Europe, as in America, the first half of the nineteenth century was marked by an apathy toward taxonomic study. During that period, Losana and Westwood had each contributed a few species and Lund and Leach had swelled the total of unrecognizable forms, but in 1845 formicid taxonomy was essentially as Latreille and Fabricius had left it forty years before. Once the interest in the field was aroused, however, the pendulum swung to the opposite extreme. In the years immediately following 1845 no less than eight European workers began publishing on ant taxonomy. Of these eight men we need consider only three here: Julius Roger, a physician who held the Post of Public Health and Anatomy in the small town of Rauden in Upper Silesia, Gustav Mayr, a professor in the University of Brunn and Frederick Smith, who for some years was an assistant in the Zoological Department of the British Museum.

It is easy to fall into the error of thinking that, because there had been few ants described at that period, the "good old days" of myrmecology were marked by a delightful simplicity which made taxonomy much easier than at present. With most of the world teeming with undescribed species and the literature limited to two or three dozen publications there is something to be said for this view. But such roseate retrospections fail to consider the difficulties which resulted from the total lack of what we now regard as the basic generic structure of ant taxonomy. Without exception the older authors had made use of collective genera as well as collective species. Instead of our well-defined present day genera they had left a number of conglomerate groups any one of which would have furnished (as most of them have) material for half a dozen modern genera. Successful work under these circumstances demanded great acumen in dealing with generic delimitations. Both Roger and Mayr possessed this characteristic to a high degree but it was one of the many desirable taxonomic qualifications which Frederick Smith lacked.

When Smith began his studies on the ants in the collection of the British Museum, he enjoyed an opportunity which has seldom if ever been equaled. Not only was the collection wonderfully rich in undescribed species and genera but it contained the Banks collection of Fabrician types. Frederick Smith was by very long odds in a position which any myrmecologist might have regarded with justifiable envy. For more than twenty years Smith published on this material, during which time he described several hundred species and not a few genera. It is safe to say that not more than a third of these could

be recognized from his descriptions. For Smith possessed what Wheeler has called a "deficient classificatory sense" and few of the species which he described had a structure sufficiently distinct to show through the verbal camouflage with which he obscured them. In addition, Smith had little regard for what other workers in the field had done, hence he frequently made synonyms. It may be said that he showed no partiality here for as often as not he redescribed his own species under new specific names. The effect of these faulty practices on Smith's contemporaries may be easily imagined. I happen to know that Julius Roger found them intolerable, for I own the copy of the 1858 *Catalogue* which Smith inscribed and sent to Roger in the following year. This volume is interleaved and copiously annotated in Roger's microscopic script. On almost every page Roger has noted one or more corrections and some of these are made with obvious acerbity. It must have been particularly annoying to Roger, who was striving to modernize the genera of Latreille and Fabricius, to watch Smith's placid disregard of Fabrician species. Smith redescribed most of them under new names and in one instance (*Solenopsis geminata*) repeated the error four times. A good deal of Roger's taxonomic work was taken up correcting Smith's mistakes and he thus became the first of several investigators who were forced to labor at this uncongenial task. Forel, with his characteristic impetuosity, once published a statement that neither Smith's descriptions nor his types could be depended upon. But while Forel's annoyance is understandable, he obviously overshot the mark. It is only because of Smith's types, or rather because of the fact that many of them were preserved in the collection of the British Museum, that Smith's work was saved from oblivion. In 1894 Mayr visited the British Museum and examined Smith's material. He was able to rectify many errors and later, through the efforts of Emery, others were eliminated. In such circuitous ways many of Smith's species have been made recognizable to other workers in the field but there still remains a large residue whose exact nature will probably never be known.

In contrast to the reprehensible work of Smith, that of Mayr is the cornerstone on which our present day taxonomy has been reared. Mayr began his studies of ants at an early age, publishing his first paper when only twenty-one years old. Thereafter he continued to publish on myrmecological topics for more than fifty years. Thus it happened that while in his youth Mayr worked with Nylander, Roger and Smith, he later became a contemporary of Emery and Forel and lived to see the advent of two other notable myrmecologists, W. M. Wheeler and F. Santschi. It is seldom that one man can claim a contemporary acquaintance with so many of the major figures in

a field. It is even less seldom that the work of one man has such a profound effect in shaping a field. At a time when most myrmecologists were content with the few genera which they had inherited from their predecessors of the eighteenth century, Mayr embarked on a course of generic delimitation which gave us many of our most important present day groups. It is significant that Mayr's name is attached to such well known genera as Camponotus, Pogonomyrmex, Aphaenogaster, Tetramorium and many others. In addition Mayr was the first formicid taxonomist to make extensive use of dichotomous keys. These keys were often presented in connection with work that amounted to a generic revision although, since the papers carried other material as well, they were not so designated. Other workers in the field of ant taxonomy have produced far more descriptive work than Mayr but it is certain that no one has made a more timely or far reaching contribution than he did. Mayr's first myrmecological interests lay almost entirely within the confines of his native Austria. Later he extended his work to include the entire European ant fauna and about 1862 turned his attention to exotic species. In this work he was joined by Roger and, since Smith had been occupied with exotics for several years, most of the development of our North American ant taxonomy at the middle of the last century lay in the hands of these three men. The death of Roger in 1865 and that of Smith ten years later would have left Mayr in possession of the field if it had not been for the entrance of two very able young myrmecologists, Emery and Forel.

Both these men matched Mayr's youthful start in the field of myrmecology for each published his first paper dealing with ants at the age of twenty-one. Like Mayr the newcomers began their studies on local faunas and for some time their interest in exotic species was slight. About 1880, however, both Emery and Forel began to publish on exotic ants. As Mayr was already well embarked on this work, it may be seen that the period from 1880 to 1900 was one of rapid expansion in ant taxonomy. Each paper of any size carried descriptions of dozens of new species and it is a tribute to the skill of all three men that comparatively few synonyms were made.

I wish at this point to discuss the parallelism which is said to have marked the lives of Emery and Forel. This concept was developed by Forel who, on the occasion of Emery's death in 1925, published an account of the similarities between Emery and himself. Most of these are of little consequence and Forel's preoccupation with them may be considered the foible of a failing septuagenarian who was approaching the end of his own life. But recurring throughout the recital is the theme of parallel activity or identical practice in the

field of myrmecology. It is this part of Forel's statement that needs elucidation, since it does not follow that because two men work together in the same field their methods or attitudes must be the same. Actually there was a highly significant difference in the way in which the two men treated ant taxonomy.

Forel received his formal training in medicine. Thereafter he did postgraduate work in neural anatomy and psychiatry. In 1879 he was appointed as the Director and physician in charge of the Cantonal Asylum at Burghölzi, Switzerland. Few people would deny that he was a genius. Not only was he an acknowledged authority in myrmecology and psychiatry but he was equally at home when practicing hypnotism or proselyting for prohibition. He possessed an abounding and infectious enthusiasm which even his severest critics found hard to resist. In his work with ants he was a superb observer in the field and keenly aware of the importance of ecological data as an aid to the structural distinctions of taxonomy. He clearly derived great pleasure from describing new species and genera of ants and did so with ability and distinction. His knowledge of what other taxonomists had done was excellent and among the great number of new ants which he described comparatively few were synonyms. But Forel clearly felt that the important function of taxonomy was the description of new forms. The character of his publications leaves no room for doubt on this point. Although he could turn out beautifully coördinated faunal studies and had many excellent opportunities to do so, he rarely produced this type of work. Despite their titles, many of his faunal studies, for example his formicid section of the *Histoire physique, naturelle et politique de Madagascar*, or that of the *Biologia Centrali-Americana*, are little more than vehicles for carrying the descriptions of new species. In both these large and important papers previously described species are listed with bibliographic citations only and neither work makes any attempt to furnish keys which would aid in a faunal study. Their value in such work is, therefore, limited almost entirely to those species which were first described in the two publications. It must not be thought that Forel was unaware of the characteristics of the species which he neglected. He knew them well, but he clearly regarded the organizational aspects of taxonomy as boring routine. It appears that he never published a generic monograph, certainly not one of any size. He was fond of publishing miscellanies in which a single paper carried descriptions of new ants from widely scattered parts of the world, a circumstance which made coördination impossible. Forel was proud of his species and genera and bitterly resented criticism of them. For the person who called one of these species in question struck at what Forel felt

was the heart of his work. And this work was of truly heroic proportions, since during his life Forel described three thousand new ants. But it is correct to state that this enormous mass of description was his major contribution to ant taxonomy.

In contrast to Forel, Carlo Emery was far less spectacular. In 1881 he was appointed Professor of Zoölogy in the University of Bologna and held this position until his retirement many years later. In his work on ant taxonomy Emery was thorough and methodical to a fault. He published many faunal studies, most of which are extensively keyed and provided with data on the previously described species as well as the new ones. He monographed several large and difficult genera with exceptional care. His view of taxonomy was always inclusive. A new species was of little significance unless it could be seen in relation to the others in the genus. His ability for specific and generic description was equal to that of Forel and the care that he put into the organization of his taxonomy was incomparably greater. Emery's work was so exact that he made even fewer synonyms than Forel, but he always welcomed the opportunity to correct such errors, and more often than not was the first to call attention to the mistake. He never lost sight of the fact that the description of a new species is only the beginning of taxonomy and no amount of comparison or difficulty in keying was too arduous for Emery if it permitted an easier recognition of the species involved. During his life Emery described almost as many new species as did Forel, but it is clear that he regarded this feat as less important than the taxonomic organization which accompanied it.

We may count ourselves fortunate that it was Emery rather than Forel who undertook the first inclusive account of North American ants. In the three-cornered competition that developed between Mayr, Emery and Forel in the closing years of the last century, Emery had the better of it as far as material from North America was concerned. This was due in part to his association with Pergande, who sent Emery much of the material on which his classic *Beiträge zur nordamerikanischen Ameisenfauna* was based. With these and other specimens Emery was able to describe, by the year 1900, more North American ants than had been recognized by all other European myrmecologists combined. By that time he had set up about one hundred and eight forms coming from our region. Of the ninety or so remaining forms Mayr had described thirty-two, Roger twenty, Forel sixteen, F. Smith ten and the older authors about a dozen. It may be seen that by the year 1900 the contributions of European myrmecologists to our ant fauna numbered about two hundred forms.

Let us now see how our own myrmecologists fared during the period

from 1845 to 1900. The record is scarcely an inspiring one for there is no American counterpart with which to match the activity in Europe during that period. In defense of our early myrmecologists it may be said that they worked with considerable odds against them. There were few adequate libraries, type material was nowhere available and specimens sent to Europe for comparison all too frequently appeared as new species under the name of some European specialist. In 1852 Haldeman re-entered the myrmecological field with the descriptions of two new species belonging to the genus Eciton. Three years later Asa Fitch described six North American ants of which three were new forms. In 1862 Walsh described two forms of Lasius and in 1865 the elder Cresson gave us the description of *Pogonomyrmex occidentalis*. During the next two years there appeared from the pen of S. B. Buckley the descriptions of sixty-seven North American ants which he regarded as new species. The numerical magnitude of this contribution is apparent when it is considered that prior to Buckley's effort there had been less than half that many species described on this side of the Atlantic. Buckley's collection was not only much larger than any previously studied by an American taxonomist but it was made up of material coming from widely separated parts of the country. As State Geologist of Texas Buckley had collected a number of ants from the central portion of that state. These Texas specimens made up slightly more than half the collection. The remaining specimens had been taken by Buckley at Washington, D. C. and Naples, N. Y., or had been given him by Norton. Most of Norton's material came from Connecticut but there were also specimens from Florida and California. In addition Norton had turned over to Buckley a series of identified European ants for purposes of comparison. Buckley worked up his ant collection in Philadelphia, where he had the reference facilities to be found in the personal library of Dr. Le Conte as well as those in the libraries of the Philadelphia Academy of Natural Sciences and the Philadelphia Entomological Society. I mention these details because it is easy to get the impression from some of Buckley's critics that his work was done in complete ignorance of the subject he was investigating. On the contrary, Buckley seems to have been fortunate in having at his disposal considerably more facilities for research than were usually available at that time. Indeed it is hard to see how his situation could have been materially improved unless he had undertaken a trip to Europe to consult type specimens. His chances for producing what might have been a monumental contribution to our ant taxonomy were excellent. What he actually did was to write a treatise that is best regarded as a myrmecological curiosity. It seems scarcely believable that with his obvious interest in the

insects which he was describing, an interest that his severest critics have never denied, Buckley should have failed to produce a single description which permits the positive recognition of any of his species. In the majority of cases it is quite impossible to determine to what genera the insects belong, for Buckley's descriptive ineptitude was equalled by his extraordinary lack of regard for generic distinction. It should be borne in mind that by 1867 Mayr and Roger had delimited most of our common genera, but even if we excuse Buckley's disregard of these men's work it is impossible to condone a neglect of previous authors which extends to Linnaeus. Buckley actually described as new, a species which he called *Myrmica rubra*. Since Linnaeus' species is described and figured in Latreille's *Histoire Naturelle des Fourmis*, a volume which Buckley had borrowed from LeConte's library, it seems reasonably clear that this same volume must have been gathering dust while Buckley penned the description of his homonym. Buckley's shortcomings have been variously attributed to lack of training, the difficulties of the subject and innate perverseness. I believe that there is a much simpler explanation. Buckley modeled his descriptions upon those of Frederick Smith. This much would be obvious from a comparison of the works of the two men even if we did not have Buckley's published statement that he was strongly influenced by his English contemporary. Buckley's choice of a mentor was a fatal one for his work. Unlike Smith he left no types by which his species might have been checked. Thus the sole factor which saved Smith's species was lacking in Buckley's case. That all of Buckley's species have not been thrown into the discard is due to the fact that in a few instances he included field data with his descriptions, which identified the insect well enough to permit Mayr, Emery and Wheeler to surmise what it was. Even so only ten of his forms survive. In this ignominious fashion ended the first major attempt at formicid taxonomy on this side of the Atlantic.

Very little additional work was done in this country in the years immediately following Buckley's fiasco. In 1868 Norton published the description of *Eciton sumichrasti* and four years later Cresson described two other species in the same genus. Between the years 1879 and 1881 McCook added a handful of new forms, while Provancher, in 1887, published several descriptions of Canadian ants. About 1893 Pergande began a series of studies dealing with North American ants. Much of Pergande's material was from Mexico but he described at least nine forms from areas in the United States. Pergande was a competent worker who knew the literature and enjoyed the respect and coöperation of his European contemporaries. When Forel visited the United States in 1899 he made a special trip

to Washington to make Pergande's acquaintance. The quality of Pergande's descriptions was superior, but his most important contribution to ant taxonomy in this country was indirectly made. As has already been mentioned he sent numerous specimens to Emery. It was Pergande's practice to divide each series sent into two halves, one of which he retained. When Emery made his half the basis for a new species, Pergande had authentic material, if not type material, of that same species in his possession. There was thus built up a valuable nucleus of specimens whose authenticity could not be questioned. These, with Pergande's own types, constituted the first significant ant collection in this country. It is to be regretted that Pergande's work with ants was of such short duration. He published little after 1895, in which year the second and final portion of Emery's *Beiträge* appeared.

To summarize the above, it is apparent that at the close of the last century the great preponderance of work on the taxonomy of North American ants had been done by Europeans. Their descriptions outnumbered those of our native myrmecologists more than two to one. The disparity was made much greater by the fact that of the hundred or so descriptions contributed by our workers more than sixty were wholly worthless. Authentic material was extremely scarce, and the majority of it was confined to the small collection made by Pergande. Despite Pergande's valuable work the taxonomy of North American ants was largely a European monopoly.

I have stressed the year 1900 because it marks the appearance in the field of myrmecology of the man who was to bring about profound changes in this situation. In the fall of 1899 W. M. Wheeler accepted a professorship in the Department of Biology at the University of Texas. Wheeler's name has come to be so intimately connected with myrmecology that it seems strange to contemplate his novitiate in this field. The early hold which the science laid upon Wheeler's European contemporaries had not marked the initial years of his career. Wheeler's earlier scientific publications had embraced a considerable variety of subjects with the major stress, perhaps, on insect embryology. He had published studies in entomological taxonomy but these had dealt with dolichopodid and empid flies. Certainly there was little to indicate that, during the next thirty-seven years of his life Wheeler would devote himself largely to the study of ants. Wheeler has stated that his initial interest in ants was occasioned when he happened to notice a number of workers of *Atta texana* carrying leaf fragments into their nest. Seven years later this chance observation had come to fruition as an elaborately documented monograph of more than a hundred pages which is still, after forty years,

one of the best accounts of the attine ants ever published. From the outset of his work with ants Wheeler refused to be discouraged by the difficulties involved in studies of their taxonomy. Where a less energetic individual might have despaired, Wheeler persisted in his efforts to build up a working collection of authentically determined species. He corresponded extensively with Forel, Emery and Pergande, each of whom sent him identified specimens. The success of his work was such that by the end of three years he had amassed enough material to publish his first generic monograph, the *Revision of the Ants of the Genus Leptothorax*. This paper must have come as a profound surprise to Emery, Forel and Mayr, for in it they could clearly see the end of the supremacy which they had enjoyed in the field of North American ant taxonomy. The same year in which this paper appeared (1903) Wheeler left the University of Texas to accept a curatorship in the American Museum of Natural History. While there he extended his interest in ant taxonomy to include various exotic groups but the majority of the taxonomic papers published during his curatorship dealt with the classification of our native species. While at Texas Wheeler had spent much time in the field, and in that state and in other parts of the southwest which he subsequently visited he collected assiduously. From this material came a large number of new species. In 1907 Wheeler visited Forel and was able to secure a splendid series of cotypes and identified specimens which greatly facilitated his studies.

In 1908 Wheeler accepted a professorship at Harvard. During the first eight years that he was there he published a number of important papers dealing with the classification of North American ants. But he was busying himself more and more with exotic material and the *Mountain Ants of Western North America*, which was published in January 1917, was the last large paper on our ants. Thereafter he published few articles dealing with North American species, although his work on exotic ants increased in volume until his death in 1937. The significant period of his work with our species lies, therefore, between 1900 and 1916. In these sixteen years he described more than two hundred and seventy forms, a contribution which so far surpasses that of any other myrmecologist as to make comparisons futile. Yet it may be stated that the most valuable contribution which Wheeler made to the taxonomy of our ants was not in the large number of new species which he described. It was rather that Wheeler carried his taxonomy into the field and amplified structural distinctions with others relating to habits, distribution and ecology. For no amount of study of expatriated specimens can furnish these vital details and until the taxonomy of our ants was brought back to this

country it perforce remained as lifeless as the preserved specimens on which it was based. It is Wheeler's singular distinction that by his indefatigable efforts he made our ant taxonomy the living thing it is today.

Family FORMICIDAE

The family Formicidae is often defined as a group of social Hymenoptera in which the worker is apterous, the antennae are geniculate and the abdominal pedicel consists of one or two segments. Whatever faults this definition may have, it points to one significant fact. The structure of the abdominal pedicel plays a very important part in the taxonomy of this group. It is used not only as one of the family characteristics, but also as a means for distinguishing the subfamilies. If the situation were always exactly as described above there would be little difficulty in this latter regard. Unfortunately the case is by no means so simple. In the subfamily Ponerinae the structure of the pedicel is subject to wide variation. A considerable number of the representatives of this subfamily have a pedicel of an intermediate character. It may be regarded as consisting of one segment or of two depending upon the view taken by the observer. In all such cases the first segment of the pedicel is well-marked but the second is not clearly distinct from the rest of the gaster. Its size is often as great as, or even greater than, the following gastric segment, from which it is usually separated by a distinct groove or impression. I have mentioned this point because there is no good agreement among myrmecologists as to how this situation is to be handled. Some follow Emery and treat this poorly defined 'node' as the postpetiole. Others make no attempt to recognize a postpetiole in such cases. Since there is no agreement as to what terminology should be employed considerable confusion has resulted. It is regrettable that some authorities treat the Ponerinae as having two petiolar segments and others regard them as having only one. But it is even more unfortunate when these two methods of treatment are combined in a single key. In the generic and subgeneric key which Wheeler published in 1922 the subfamily Ponerinae is separated on the basis of a single segment in the abdominal pedicel. Yet there are repeated references to the postpetiole in the key to the ponerine genera.

Much of this confusion could be avoided if the stress were placed on the gaster rather than on the petiolar segments. Except in the case of a few African Dorylinae and some Australian Cerapachyinae there is little doubt about the limit of the gaster regardless of whether

there are two petiolar nodes or one. It is significant in this connection that Emery, despite the fact that he regarded the first gastric segment of most ponerines as the postpetiole, always included this segment when he spoke of the gaster of these insects. Since there is such excellent agreement as to what the term gaster implies in the case of ants, this fact may be put to good use in dealing with the above difficulty. In the overwhelming majority of the ponerines the gaster is different from that of most other ants; thus the subfamily may be separated on the basis of gastric structure without any chance for confusion since under this plan it is not necessary to mention the pedicel at all. This plan has been followed in the key below and I have also used this same character to bring out our representatives of the Cerapachyinae. I am aware that this distinction will not apply uniformly in that subfamily nor will the characters which have been used to separate the Cerapachyinae from the Ponerinae. But, since the Cerapachyinae are transitional in so many respects it seemed best to avoid doubtful generalizations and treat our few representatives in a way which puts certainty of recognition in first place.

The key which follows will apply only to the worker and female. In it, as in other keys presented elsewhere in this volume, no attempt has been made to deal with the male caste. There is reason to believe that at present there is no altogether satisfactory method for handling male ants if they are dissociated from the worker and female. Dr. M. R. Smith, who recently published an exhaustive monograph (1943) dealing with generic and subgeneric characters of male ants, was at pains to point out certain difficulties inherent in such an attempt. The structure of the male is often remarkably inconstant and this variability requires extensive qualification in the case of key characters. By the time these have been whittled down to care for all the possible exceptions there is usually not much left of them. If I understand Dr. Smith correctly, the generic habitus of most male ants is an extremely subtle matter and one which 'often defies accurate description'. It seems plain enough that the ordinary dichotomous key is not sufficiently flexible to handle these subtleties and that one might do as well or better with unkeyed illustrations as a guide to generic habitus in the male. At least this is the method followed in the present volume. The majority of the plates which have been prepared to show generic characteristics carry a figure of the male. Those who prefer to work with keys are referred to Dr. Smith's 1943 monograph, which is by far the best presentation of this subject that has yet appeared.

Key to the Subfamilies

1. Gaster with a distinct constriction between the first and second segments or, if this constriction is faint, the mandibles are linear and the petiole is produced into a conical dorsal spine....2
   Gaster without any constriction between the first and second segments..3
2. Antennal scape short and very stout, even at the base, the scape flattened throughout or with a greatly enlarged tip which bears a prominent lateral furrow for the reception of the funiculus....*Cerapachyinae*
   Antennal scape not as above, usually long and slender, but if short and enlarged at the tip, at least the basal third of the scale is slender..*Ponerinae*
3. Abdominal pedicel consisting of two segments....4
   Abdominal pedicel consisting of one segment....6
4. Frontal carinae narrow and not expanded laterally so that the antennal insertions are fully exposed when the head is viewed from above....5
   Frontal carinae expanded laterally so that they partially or wholly cover the antennal insertions when the head is viewed from above..*Myrmicinae*
5. Eyes very large, suboval or reniform and consisting of several hundred fine ommatidia....*Pseudomyrminae*
   Eyes vestigial or absent, if present consisting of a single ocellus-like structure....*Dorylinae*
6. Cloacal orifice distinctly circular and usually surrounded by a fringe of hairs....*Formicinae*
   Cloacal orifice slit-like, the hairs, when present, not forming an encircling fringe....*Dolichoderinae*

Subfamily PONERINAE

The subfamily Ponerinae is regarded as a very primitive group of ants. This is apparent both in their structure and habits. Although there are ponerine genera in which certain features are highly specialized, their general structure has undergone very little evolutionary advance. Throughout most of the subfamily the worker caste shows a condition of primary monomorphism. The worker closely approaches the female in size and there is no tendency toward the production of medias or minors in the worker caste. The habits of these ants show a comparable lack of specialization. The group is uniformly carnivorous. The workers collect other insects or small arthropods and these are cut to pieces and fed directly to the larvae. Regurgitation seems to play a much smaller part in the life of the colony than is the case in the higher subfamilies. The nest-founding reactions of the ponerine female are also primitive. During the rearing of the first brood she leaves the nest to forage for food and it is presumed that she does not utilize salivary secretions to feed the larvae. There would seem to be no morphological reason why she might not do so, for Haskins and

Enzmann have shown (1938) that in many ponerine genera the wing muscles of the female degenerate after deälation as is the case in the higher subfamilies.

While the representatives of some ponerine genera are very aggressive and pugnacious none of the species which occur in the United States show these traits. In general they are inoffensive or even timid ants which form small colonies and exhibit few spectacular characteristics. Except for Stigmatomma, which is more abundant in the northern part of the country than in the south, all the other genera clearly belong to the southern component of our ant fauna. This is true even in the case of Ponera for, although one species of this genus has a range which reaches New England and southern Canada, its primary representation is in areas further south. The only part of the United States in which ponerine ants are found in any degree of abundance is the region bordering the Gulf of Mexico and the Mexican boundary. Even in this region the incidence notably increases from north to south. The two areas which support the greatest ponerine population are southern Florida and the Brownsville region in southwestern Texas. In the northern half of the United States these insects make up a very minor and inconspicuous part of our ant fauna.

Key to the Genera of the Subfamily Ponerinae

1. Gaster without a distinct constriction between the first and second segments; node of the petiole forming a conical spine above; mandibles linear and inserted near the midline of the head; antennal fossae bounded in the rear by a rounded ridge which runs diagonally inward from the eye ..... *Odontomachus*
   Gaster with a distinct constriction or groove between the first and second segments; node of the petiole blunt or rounded above; mandibles inserted at the sides of the head; antennal fossae not bounded in the rear by a diagonal ridge 2
2. Anterior border of the clypeus denticulate; mandibles with a row of coarse, bidenticulate teeth ..... *Stigmatomma*
   Anterior border of the clypeus variously shaped but never denticulate; mandibular teeth, when present, single 3
3. Thoracic dorsum without sutures, at most a shallow impression at the point at which the suture should be, usually not even an impression present 4
   Thoracic dorsum with at least the promesonotal suture present, and usually the mesoepinotal suture present as well 6
4. Apex of the gaster directed ventrally or anteroventrally when the major axis of the gaster is in line with that of the thorax; head and thorax punctato-granulose or punctato-rugose, gaster smooth with numerous piligerous punctures 5

Apex of the gaster directed to the rear when the major axis of the gaster is in line with that of the thorax; head, thorax and gaster covered with even, straight, longitudinal rugae ..... *Ectatomma*

5. Petiole scalelike, the front and rear faces flattened; anterior border of the clypeus not projecting in the middle ..... *Proceratium*
   Petiole nodiform, low and much rounded above; clypeus with a narrow median lobe which projects strongly beyond the rest of the anterior border ..... *Sysphincta*
6. Tarsal claws distinctly pectinate; mandibles without distinct teeth ..... *Leptogenys*
   Tarsal claws simple; mandibular teeth usually distinct 7
7. Cheek with a distinct carina extending from the eye to the clypeus ..... *Neoponera*
   Cheek without a carina 8
8. Pronotum marginate on either side ..... *Pachycondyla*
   Pronotum not marginate on either side 9
9. Thoracic dorsum with only the promesonotal suture present; clypeus flat, the suture which separates it from the front of the head indistinct ..... *Platythyrea*
   Thoracic dorsum with both the promesonotal and mesoepinotal sutures present; clypeus with a projecting median lobe, the suture which separates the clypeus from the front of the head clearly distinct 10
10. Tibia of the middle and hind legs with a single spur ..... *Ponera*
    Tibia of the middle and hind legs with two spurs, the smaller lateral spur often obscure ..... *Euponera*

The difference in the tibial spurs used to separate *Ponera* and *Euponera* is often difficult to utilize because of the small size of the lateral spur. For practical purposes the three groups involved are more easily separated as follows:

1. Middle tibiae with stiff hairs on the extensor surfaces; eyes small, the facets indistinct ..... *Euponera* Subgenus *Trachymesopus*
2. Middle tibiae without stiff hairs on their extensor surfaces; eyes of moderate size, their facets very distinct ..... *Euponera* Subgenus *Brachyponera*
3. Middle tibiae without stiff hairs on their extensor surfaces; eyes small, their facets indistinct ..... *Ponera*

Genus STIGMATOMMA Roger

(Plate 1, figures 1–5)

The primitive and wide-spread genus Stigmatomma is represented in North America by a single species, *S. pallipes*. The habits of this interesting insect have been repeatedly studied, the latest and most inclusive account being that of Haskins (1928 *et seq.*). Haskins has

been able to show that the female of *pallipes* forages for food during the period of nest-founding. This trait, also found in other archaic Ponerine genera, is regarded as primitive and ancestral to the closed type of nest-founding practiced by most ants. Haskins' observations are of much interest since they prove that the nesting behavior of *pallipes* is in accord with its strikingly primitive structural features. According to the above author the main diet of *pallipes* consists of small geophilid centipedes. Fragments of small insects are also frequently used as food. These are fed directly to the larvae, again a primitive habit, without recourse to regurgitation.

The great majority of records for *pallipes* and its several subspecies come from regions characterized by heavy cover and considerable precipitation. This has led to the belief that the range of this insect is coincidental with such areas. From a statistical standpoint the records are overwhelmingly in favor of such an interpretation. Indeed, the only contrary one appears to be that of the insect which I took at Elmo, Kansas and later described as the subspecies *subterranea*. In discussing the peculiar situation of the nest of *subterranea*, I pointed out that if this subspecies is able to lead a hypogaeic existence on the dry and open plains of Kansas, there is a possibility that the range of *pallipes* may blanket much of the United States and southern Canada. If this ant becomes epigaeic only in moist, wooded areas it will not be easy to implement our present knowledge of its range. It is only by accident that a hypogaeic ant which lives well below the surface is apt to be discovered. Nevertheless I believe that in the future records of *pallipes* will be forthcoming from areas where it is not known to occur at present.

Key to the subspecies of Stigmatomma pallipes Haldeman

1. Inner border of the mandible strongly sinuate, the portion bearing the double teeth forming a marked convexity 2
   Inner border of the mandible not sinuate, the portion bearing the double teeth straight or nearly so ..... *pallipes* subsp. *oregonense*
2. Funicular joints 2–5 at least twice as broad as long; largest worker 5 mm. in length ..... *pallipes* subsp. *montigena*
   Funicular joints 2–5 about as long as broad or longer than broad; largest worker 6.5 mm. in length 3
3. Occiput slightly but distinctly concave; median teeth of the clypeus smaller and finer than the flanking teeth; color ferrugineous, the head and thorax scarcely or not at all darker than the gaster .... *pallipes* subsp. *subterranea*
   Occiput flat; median teeth of the clypeus as large as the flanking teeth; color (in mature specimens) dull brown to piceous brown, the head and thorax usually darker than the gaster ..... *pallipes*

1. Stigmatomma pallipes (Haldeman)

Typhlopone pallipes Haldeman, Proc. Acad. Nat. Sci. Phila., Vol. 2, p. 54 (1844) ♀.

S. pallipes Emery, Zool. Jahrb. Syst., Vol. 8, p. 261 (1895) ♀ ♀ ♂; Wheeler, Biol. Bull., Vol. 2, p. 65, figs. 5, 6, 7 (1900) ♀ ♀ ♂; Creighton, Amer. Mus. Novitates, No. 1079, p. 3 (1940) ♀ ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 532, pl. 2, fig. 5 (1947) ♀.

S. pallipes subsp. *arizonense* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 389 (1915) ♀.

S. pallipes var. *wheeleri* Santschi, Ann. Soc. Eng. Belg., Vol. 57, p. 429 (1913) ♀ ♀ ♂.

S. serratum Roger, Berl. Ent. Zeitschr., Vol. 3, p. 251 (1895) ♀.

Arotropus binodosus Provancher, Canadian Nat., Vol. 12, p. 207 (1881) ♀.

Type locality: none given. Types: None known to exist. Autotypes in the collection of the Boston Society of Nat. Hist.

Range: southern Ontario and Quebec south to the Gulf coast with a sporadic distribution in Texas and the southern Arizona mountains. In the Appalachian highlands the insect occurs at elevations below 3000 feet.

In my publication dealing with *S. pallipes* I presented reasons for synonymizing *arizonense* and *wheeleri* with the typical *pallipes*. Since that time I have received, from Dr. L. G. Wesson, additional information concerning the first of these two forms. It may be recalled that I discussed the possibility that the single specimen on which *arizonense* was based might have been a mislabelled representative of our eastern subspecies. I was prepared to believe that the insect does not occur in Arizona. This view has since been nullified by the discovery of two additional Arizona specimens of *pallipes* by R. G. Wesson. I have not examined the specimens but Dr. Wesson, who has compared them with the eastern form, writes me that the differences "are not particularly impressive". Thus, while there seems to be no reason to reestablish the subspecies *arizonense*, it will be necessary to recognize a considerable addition to the range of the typical *pallipes*.

2. Stigmatomma pallipes montigena Creighton

Stigmatomma pallipes subsp. *montigena* Creighton, Amer. Mus. Novitates, No. 1079, p. 7 (1940) ♀ ♀.

Type locality: Little Switzerland (3400′) near Spruce Pines, N. C.

Type: A.M.N.H. Paratypes: M.C.Z., Coll. W. S. Creighton.

Range: this subspecies replaces the typical *pallipes* at higher elevations in the mountains of the southeastern United States. It intergrades with *pallipes* to produce the form which Santschi has called *wheeleri*.

3. Stigmatomma pallipes oregonense Wheeler

Stigmatomma pallipes subsp. *oregonense* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 389 (1915) ♀ ♀; Creighton, Amer. Mus. Novitates, No. 1079, p. 7 (1940) ♀ ♀.

Type loc: worker, Marion County, Oregon; female, Olympia, Washington. Types: A.M.N.H., M.C.Z.

Range: low elevations in the coastal mountains of Oregon, Washington and British Columbia.

4. Stigmatomma pallipes subterranea Creighton

Stigmatomma pallipes subsp. *subterranea* Creighton, Amer. Mus. Novitates, No. 1079, p. 8 (1940) ♀ ♀.

Type loc: Elmo, Kansas. Type: A.M.N.H. Paratypes: M.C.Z., Coll. W. S. Creighton.

Range: known only from type material.

Genus Platythyrea Roger

(Plate 2, figures 1–3)

The tropicopolitan genus Platythyrea has a single representative, *P. punctata*, which occurs in the southern United States. The records for this species indicate that it is confined to the southern tip of Florida and the area immediately around Brownsville, Texas. *P. punctata* is not likely to be confused with any of our other ponerines. In addition to its characteristic thoracic structure (see key) it has, when fully mature, a peculiar greyish black color and a dull, mattelike surface which give it a very distinctive appearance.

The habits of *punctata* have been observed by Forel in Barbados (1899), Wheeler in the Bahamas (1905) and M. R. Smith in Puerto Rico (1936). The insect prefers to nest in old stumps or logs or under the bark of trees in shady situations. The workers are active and forage singly. The colonies are small consisting of from fifty to two hundred individuals. It is both carnivorous and predatory.

1. Platythyrea punctata (F. Smith)

Pachycondyla punctata F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 108 (1858) ♂.

Platythyrea punctata Roger, Berl. Ent. Zeitschr., Vol. 7, p. 173 (1863); Forel, Rev. Suisse Zool., Vol. 9, p. 335 (1901); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 533, pl. 3, fig. 9 (1947) ♀.

Platythyrea inconspicua Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 961 (1870) ♀; Emery, Ann. Soc. Ent. Fr. (6), Vol. 10, p. 56 (1890) ♀.

Type loc: San Domingo. Type: British Museum.
Range: southern Florida and southwestern Texas and southward through the Antilles and Central America.

Genus ECTATOMMA F. Smith

The genus Ectatomma is represented in America north of Mexico by a single species, *E.* (*Parectatomma*) *hartmani.* This insect is very imperfectly known. It was described by Wheeler in 1915 from one worker which was taken at Huntsville, Texas. There are no additional records to show that it has been found again. In contrast to our lack of knowledge concerning *hartmani* there is a large and entertaining body of literature dealing with the behaviour of *E. tuberculatum* in Texas. This is the famous "kelep", whose introduction into the United States was attempted in the hope that the ant would control the ravages of the cotton-boll weevil. The introduction of *tuberculatum* into Victoria County, Texas in 1904 was given a great deal of publicity. It is not surprising that when Wheeler expressed doubts as to the ability of the insect to acclimatize itself he was taken to task for his views. The most vociferous champion of the "kelep" was Dr. O. F. Cook, who published several reports dealing with the habits of *tuberculatum* (1904 *et seq.*). The zeal which Dr. Cook exhibited in defense of the "kelep" appears to have been considerably greater than his knowledge of myrmecology. He was very soon in serious difficulty with Wheeler. The latter had little patience with Cook's "Corybantic enthusiasm" and less for his peculiar interpretation of facts. The exchange of opinion between the two men was continued over a period of two years. Dr. Cook held up manfully under a very heavy fire but was presently faced with the uncomfortable realization that *tuberculatum* was not becoming acclimatized, precisely as Wheeler had predicted. This put an end to Cook's publications on the "kelep" and terminated an unusually bizarre episode in myrmecological literature.

Subgenus PARECTATOMMA Emery

1. ECTATOMMA (PARECTATOMMA) HARTMANI Wheeler

Ectatomma (*Parectatomma*) *hartmani* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 390 (1915) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 535 (1947) ♀.
Type loc: Huntsville, Texas. Type: M.C.Z.
Range: known only from the single type.

There has been considerable confusion in regard to this species and much of this is undoubtedly due to the fact that it is known only from a single type specimen. I have ventured to propose an altogether different method of treatment for *hartmani* from that employed by Dr. M. R. Smith in 1947. Dr. Smith utilized the presence of bifid tarsal claws as the separatory character for the genus *Ectatomma*. I believe that he is mistaken in supposing that this character holds throughout the genus. I have not examined the type of *hartmani* since Dr. Smith's 1947 generic monograph appeared, hence I cannot state that the claws of *hartmani* are simple. I feel sure, however, that this is the case for this condition is regularly encountered in the closely related subgenus *Gnamptogenys*. While I have utilized the lack of distinct sutures on the thoracic dorsum of *hartmani* as a means for separation, there is an even simpler method of recognition. The beautifully regular longitudinal rugae which cover all parts of this insect distinguish it clearly from any other North American species.

Genus PROCERATIUM Roger

(Plate 3, figures 1–4)

Up to the present time only five representatives of the genus Proceratium have been described from North America. With so few forms involved the chance for taxonomic confusion ought to be slight. It is somewhat disconcerting, therefore, to discover that only one of these five forms, *P. croceum*, is easily and certainly recognizable. The remaining four have become involved in an intricate taxonomic tangle, for which there seems to be no altogether satisfactory solution at present.

In 1863 Roger set up the genus Proceratium to include his new North American species *silaceum* as well as his older *croceum*, which he had earlier placed in the genus Ponera. The differences which separate these two species are very distinct and little difficulty would have resulted if Roger's plan had been followed. But the matter was put in a very different light when Emery described a third species, *crassicorne*, thirty years later. In preparing his *Beiträge* Emery studied specimens of *croceum* and *silaceum* which Roger had sent to him. Whether these were types is not clear. Emery speaks of them as 'original examples'. But at least it is certain that Roger had identified these specimens and if they were not types they had been compared with type material. The specimen of *silaceum* was imperfect, the abdomen and petiole having been broken off, but Emery was able to remedy this defect, since he had three workers referable to

silaceum. These specimens, which Pergande had sent him, came from Beatty, Pennsylvania. Emery also had a single female of *silaceum* which had been loaned him by Mayr.

On the basis of these five specimens Emery redescribed *silaceum* and confirmed the wide differences which separate that species from *croceum*. But Emery was not content to let the matter rest, for he had two additional specimens which he was not willing to fit into Roger's scheme. Both these specimens had been taken by Pergande in or near Washington, D. C. According to Emery, these two specimens were slightly smaller than *silaceum* (2.33 mm. against 2.75 mm. for *silaceum*) and had a lower petiolar node and thicker antennae, with the joints of the scape, except the last, all much wider than those of *silaceum*. As a result Emery considered these specimens as representing a new species, which he called *crassicorne* and, since one of his specimens was a little more hairy than the other, he made the hairier one the type of the variety *vestitum*. Before he did so, however, Emery secured a statement from Pergande that all of the specimens which he had collected in the type locality of *vestitum* (Charlton Heights, Md.) were also hairy. This was the situation in 1915 when Wheeler, on the basis of five specimens, added the subspecies *rugulosum* to *silaceum*. In making his comparison Wheeler had what appears to be a part of the nest series from Beatty, Pennsylvania, which Emery had used in his redescription of *silaceum*. Wheeler regarded these four specimens from Beatty as cotypes of *silaceum* (which they certainly are not) and marked them with a cotype label. As far as I know, they are still so marked, although when I examined them in 1938 they had been placed with material identified as *vestitum*.

I have no wish to seem unduly harsh in evaluating the above work. *P. silaceum* is never an abundant ant and other myrmecologists as well as Emery and Wheeler have been forced to deal with limited amounts of material. Yet it is not unreasonable to claim that neither Emery nor Wheeler exercised the caution which the circumstances demanded. Emery had seen only seven specimens, Wheeler only nine. Neither man had a field acquaintance with the insects they were studying. It is not surprising, therefore, to find that each of the three new forms which they set up is highly suspect. In my opinion, *crassicorne*, *rugulosum* and *vestitum* are all synonyms of *silaceum*. In the following paragraphs I have presented the reasons on which this opinion is based.

In past years I have taken many colonies of Proceratium in various stations in the southeastern United States. In the majority of these colonies there were workers whose golden yellow color marked them as callows. While they had not attained the rich, chestnut brown

color of the mature worker these callows were active in the colony, since their integument had become hard. It is evident that the worker of Proceratium colors slowly, even for a ponerine, and that most colonies will contain a considerable number of light-colored workers during the spring and summer months. While Proceratium shows a certain flexibility in nest sites, it clearly prefers to nest in 'red rotten' logs. In such situations the color of the punky wood blends remarkably with that of the fully colored workers. The golden yellow workers, on the other hand are very conspicuous. For this reason they are sometimes the only specimens secured. This circumstance has undoubtedly contributed to the confusion which surrounds *silaceum*.

When such golden yellow individuals are examined under a microscope much more light is reflected than is the case with the fully colored workers. This glare largely obliterates certain details of surface sculpture. This is particularly true of the rugose-reticulate sculpture on the head which may, in strong lights, be scarcely visible. I believe that this is due to the fact that the rugae are nearly transparent in the yellow specimens and that they do not cast shadows as they do when they become darker. It may further be noted that the extent to which the body hairs are erected usually bears a close correlation to the degree of coloration in the worker. In the golden yellow specimens many of the body hairs are reclinate or appressed. As the color deepens more and more hairs become erect. Since the hairs also darken with age, it is easy to get the impression that the fully colored worker is much more pilose than the callow.

In my opinion, the above facts will explain the recognition of the variety *vestitum* and the subspecies *rugulosum*. The first was said to be a more hairy and more coarsely punctured version of *crassicorne*. The second differed from *silaceum* only in its darker color and heavier sculpture. But Emery's recognition of *crassicorne* cannot be explained on this basis. As already noted, *crassicorne* was supposedly distinguished from *silaceum* by its slightly smaller size, its lower and thicker petiolar node and its thicker funicular joints. There is very little reason to put much faith in the matter of size difference. Since Emery had only one specimen of *crassicorne* and four workers of *silaceum*, he could scarcely have been expected to realize that the size range in most nest series of *silaceum* embraces the size of *crassicorne* also. The difference in the width of the funicular joints is also of less significance than might be supposed. According to Emery the last funicular joint of *silaceum* is the same length as the preceding four joints taken together, while that of *crassicorne* is distinctly longer than the preceding four joints taken together. Emery's figures do not bear this

out for, if allowance is made for the fact that the funiculus of *silaceum* is figured as strongly curved, the proportion of the terminal joint to the preceding four is almost identical in both species. The same consideration applies to the structure of the petiolar nodes. Emery's figure of *silaceum* is drawn with the node of the petiole close to the declivious face of the epinotum. In his figure of *crassicorne* the node is sloped away from the declivious face of the epinotum. This gives the impression that the node of *crassicorne* is lower than that of *silaceum*. If the figure of *crassicorne* is enlarged to the size of that of *silaceum* and the angle of the petiole altered to conform with that of the latter insect, the two figures are practically identical when superimposed. In this case Emery seems to have been the victim of an optical delusion which resulted from the position in which he drew the petiole of *crassicorne*.

It is interesting to note that most myrmecologists have avoided any mention of *crassicorne* unless it was absolutely necessary to do so. The only attempt to deal with this species in any detail appears to be that published by the Wessons in 1940. According to these investigators the nests of *crassicorne* show a contrast to those of *silaceum*, since *crassicorne* nests both in rotten wood and in the soil while *silaceum* nests only in rotten wood. I cannot attach much significance to this distinction for, if I understand the matter correctly, the specimens which the Wessons discovered in soil seem to have been strays. The only clearly established nest of *crassicorne* which they mention was in all respects comparable to those of *silaceum*.

Key to the species of Proceratium

1. Length 3.75–4 mm.; node of the petiole seen in profile thick and blunt above, the base very little thicker than the crest; epinotal teeth prominent ..... *croceum*

   Length 2.75 mm. or less; node of the petiole in profile slender, the base notably thicker than the crest; epinotal teeth very short, scarcely more than angles ..... *silaceum*

1. Proceratium croceum (Roger)

Ponera crocea Roger, Berl. Ent. Zeitschr., Vol. 4, p. 288 (1860) ♀.
Sysphingta crocea Mayr, Sitzungsb. Akad. Wiss. Wien., Vol. 53, p. 501 (1866) ♀.
Proceratium croceum, Mayr, Verh. Zool- bot. Ges. Wien, Vol. 36, p. 437 (1886); Emery, Zool. Jahrb. Syst., Vol. 8, p. 264, pl. 8, figs. 5, 6 (1895) ♀ ♀; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 23, p. 390, figs. 1–3 (1930) ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 532, pl. 2, fig. 6 (1947) ♀.

Type loc: 'the state of Carolina'. Types: none in this country.
Range: Gulf Coast region from eastern Texas to Florida and sporadically north to latitude 38°.

2. Proceratium silaceum Roger

Proceratium silaceum Roger, Berl. Ent. Zeitschr., Vol. 7, p. 172 (1863) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 265, pl. 8, figs. 7, 8 (1895) ♀ ♀; Emery, Bull. Soc. Ent. Fr., p. 101, fig. 2 (1896) ♀; Kennedy & Talbot, Proc. Indiana Acad. Sci., Vol. 48, p. 202, figs. 1–7 (1939) ♀ ♀ ♂.
P. silaceum subsp. *rugulosum* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 390 (1915) ♀ ♀.
P. crassicorne Emery, Zool. Jahrb. Syst., Vol. 8, p. 265, pl. 8, figs. 9, 9a (1895) ♀.
P. crassicorne var. *vestitum* Emery, Ibid., p. 266 (1895) ♀.
Type loc: 'North America'. Types: none in this country.
Range: most of the United States east of the Mississippi River except southern Florida, northern New York and New England. This insect has also been taken in southern Ontario by Dr. Kennedy. These Canadian records (Pelee Island and vicinity) are, however, no further north than others from Pennsylvania and southern New York.

Genus Sysphincta Roger

(Plate 4, figures 1–2)

For most students of North American Formicidae the genus Sysphincta is exemplified by the extraordinary gastric configuration found in *S. pergandei*. In this species the dorsum of the first gastric segment is greatly expanded and strongly curved. As a result the posterior edge of this segment actually lies at the middle of the lower surface of the gaster. The whole posterior half of the gaster consists of the rounded dorsum of the first segment. The remaining gastric segments form a conical projection which points forward and downward from the middle of the gaster. While all the members of the genus Sysphincta possess a gaster in which the tip is reflected, the degree of curvature is seldom so extreme. In some of the species, among them *melina*, the reflected gastric tip appears to be tucked under the posterior end of the gaster, a condition very similar to that which occurs in the related genus Proceratium. For this reason Sysphincta is best separated from Proceratium by using Emery's criteria of the angular, projecting median lobe of the clypeus and the feebly incrassate antennal scapes. In Proceratium the clypeus lacks the angular, projecting, median lobe and the antennal scapes are notably thickened at the tips.

The rarity of the two species which represent the genus Sysphincta in North America has become a myrmecological by-word. In the case

of *S. melina* there is nothing to controvert such a view. During more than eighty years since its description by Roger it has been taken once. A different situation marks our knowledge of *pergandei*. While the number of specimens in collections is small the locality records of this handful of material present a rather surprising picture. *S. pergandei* has now been taken in nine eastern states and its known range extends from southern New York to northern Alabama and Mississippi. At present the recorded western limit of the range is central Ohio. In view of this rather extensive range it seems clear that the rarity of *pergandei* is not an outcome of restricted distribution. Perhaps it would be more correct to say that *pergandei* is a very elusive ant rather than a very rare one.

The data concerning the nesting habits of *pergandei* is fragmentary and contradictory. In 1905 Wheeler cited the fieldwork of Schmitt who found this insect under large stones in damp meadows. This observation has been repeated by people whose own findings negate it. There is equally good, if not better, evidence to show that *pergandei* nests on rocky hillsides where the cover is dense. There is reason for believing that the insect is subterranean in habit but its feeding responses have not been ascertained with certainty. A very suggestive approach to this last problem has been made by L. G. and R. G. Wesson (1940), who had the good fortune to secure a single colony of *pergandei* and keep it under observation. This nest consisted of a queen, eleven workers and eight males. Since it was found in close proximity to a nest of *Camponotus castaneus* the artificial nest was made to include both colonies. The *castaneus* workers were excluded from the chamber housing the *pergandei* colony but the latter could enter the chamber containing the *castaneus* workers and brood. The results failed to show any special relationship between the two species. On the other hand the members of the *pergandei* colony soon began to attack and kill each other. As this is usually an index of faulty environmental conditions one is tempted to wonder if the enforced proximity to the *castaneus* colony may not have produced this result. Attempts to feed the *pergandei* colony with various sorts of living and dead insects also gave negative results for the most part. The only insect food which the workers were observed to accept consisted of the gasters of formicine ants. On the basis of these studies the Wessons suggest that *pergandei* may feed upon dead or dying ants.

Key to the species of Sysphincta

1. Anterior portion of the petiole depressed, the posterior portion forming a low but distinct scale; reflected dorsum of the gastric segment not strongly projecting to the rear and forming an even curve with the reflected tip;

length 3.5 mm..... *melina*
Petiole evenly convex above, the anterior portion not depressed; reflected dorsum of the gastric segment strongly projecting to the rear so that the reflected tip appears to arise from the mid-ventral surface of the gaster; length 4.0 mm..... *pergandei*

1. Sysphincta melina (Roger)

Ponera melina Roger, Berl. Ent. Zeitschr., Vol. 4, p. 291 (1860) ☿ ♀ ♂.
Proceratium melinum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 438 (1886).
S. melina Emery, Zool. Jahrb. Syst., Vol. 8, p. 263, pl. 8, figs. 1–3 (1895) ☿ ♀ ♂.
Type loc: "Carolina". Types: none in this country.
Range: known only from the type material and a few other specimens taken by Schmitt in Pennsylvania.

2. Sysphincta pergandei Emery

Sysphincta pergandei Emery, Zool. Jahrb. Syst., Vol. 8, p. 264, pl. 8, fig. 4 (1895) ☿; Emery, Bull. Soc. Ent. Fr., p. 101, fig. 1 (1896) ♀; Emery, Genera Insectorum, Fasc. 118, pl. 2, fig. 6 (1911) ♀; M. R. Smith, Ent. News, Vol. 39, p. 242 (1928) ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 532, pl. 2, fig. 7 (1947) ☿.
Type loc: "Pennsylvania and District of Columbia". Types: none in this country.
Range: eastern United States. Southern New York to northern Alabama and Mississippi and west to Ohio. Most of the records appear to come from hilly or mountainous areas.

Genus Neoponera Emery

(Plate 5, figures 1–4)

Neoponera is a New World genus with most of the species occurring in Central America and tropical South America. The number of species which range northward into Mexico is small and of these only one, *N. villosa*, reaches southwestern Texas. The insect which Forel described in 1901 as *Neoponera agilis* was said to have been taken in California but this has been generally regarded as an error in the locality. It is possible that the locality referred to some region in Lower California but it is very unlikely that *agilis* occurs within our borders. These insects frequently reach our ports in shipments of tropical fruit, etc., but they do not appear to be able to establish themselves after introduction. The endemic *N. villosa* is, therefore, the only member of the genus which need be considered.

1. Neoponera villosa (Fabricius)

Formica villosa Fabricius, Syst. Piez., p. 409 (1804) ♀.
Ponera villosa Illiger, Mag. Insectenk., Vol. 6, p. 194 (1807) ♀; Roger, Berl. Ent. Zeitschr., Vol. 5, p. 1 (1861) ♀.
Pachycondyla villosa Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 720 (1862); Mayr, Sitzungsb. Acad. Wiss. Wien, Vol. 61, p. 397 (1870) ♀; Emery, Ann. Soc. Ent. Fr. (6), Vol. 10, p. 74 (1890) ♀; Forel, Biol. Cent. Amer., Vol. 3, p. 14 (1899).
Neoponera villosa Emery, Ann. Soc. Ent. Belg., Vol. 45, p. 47 (1901); Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 47 (1901) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 536, pl. 3, fig. 11 (1947) ♀.
Ponera bicolor Guérin, Icon. Règne Anim., Vol. 7, Ins. p. 242 (1845) ♀.
Ponera pilosa F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 95 (1858) ♂.
Ponera pedunculata F. Smith, Ibid., p. 96, pl. 6, fig. 25 (1858) ♀.
Type loc: "Meridional America". Types: none in this country.
Range: southwestern Texas through Mexico and Central America and as far south in South America as Paraguay. In Texas this insect appears to be mainly confined to a region extending about one hundred and fifty miles north of Brownsville. According to Wheeler it does not occur north of the latitude of San Antonio.

Genus Pachycondyla F. Smith

(Plate 6, figures 1–4)

This genus, like Neoponera, is mainly confined to the Neotropical Region. The subspecies *montezumia*, which belongs to the widely distributed *P. harpax*, is the only representative of Pachycondyla in the United States. This subspecies occurs in southern Texas. The entire range of *montezumia* extends through Mexico and into Central America. Thereafter it is replaced by the typical *harpax*, whose range extends as far south as Paraguay. The records for *montezumia* coming from Texas lie principally in a triangular area marked by Houston on the east, San Antonio on the west and Brownsville on the south. There is less certainty than might be wished as to the eastern limit of this range. Wheeler has published a Louisiana record for *montezumia* but the scarcity of records east of Houston make this appear exceptional.

The habits of *montezumia* were described in a paper which Wheeler published in 1900. The insect constructs small, irregular nests in the soil under stones and logs. The workers avoid direct sunlight, foraging early in the morning and keeping in the shade as much as possible. They feed upon other insects and myriapods.

1. PACHYCONDYLA HARPAX MONTEZUMIA F. Smith

Pachycondyla montezumia F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 108 (1858) ♀ ♂.

Pachycondyla harpax subsp. *montezumia* Forel, Biol. Cent. Amer., Vol. 3, p. 12 (1899) ♀.

Pachycondyla harpax Wheeler, Biol. Bull., Vol. 2, p. 4–6, fig. 2, 3, 8 (1900) ♀ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 401 (1908) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 537, pl. 2, fig. 8 (1947) ♀.

Ponera amplinoda Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 171 (1866) ♀.

Pachycondyla orizaba Norton, Amer. Naturalist, Vol. 2, p. 8 (1868) ♀.

Type loc: Mexico. Type: Brit. Mus.

Range: south central and southwestern Texas through Mexico to Central America.

Genus EUPONERA Forel

(Plate 7, figures 1–4)

The genus Euponera is represented in America north of Mexico by three species but of these three only one, *gilva*, is clearly endemic to this region. Of the other two species there can be no question that *solitaria* has been imported. The situation is by no means so clear in the case of *stigma*. This insect occurs widely in tropical America both in the Antilles and on the continent. Its presence in southern Florida may indicate a range which extends southward through Cuba, particularly as it is by no means rare in that island. On the other hand although *stigma* occurs in Mexico, there are, apparently, no records from southern Texas. Since there are several ponerine genera whose ranges reach the Brownsville area of Texas from Mexico but which lack representatives in Florida, the reversal of the usual situation in the case of *stigma* may be an indication that it has been introduced into Florida. The writer inclines to this belief but at present too little is known about the Florida representatives to permit a positive statement in this regard.

The habits of the three species differ only in minor details. They all prefer to nest in moist, dead logs or stumps. It is interesting to note, however, that *stigma* and *solitaria* will occasionally nest in moist soil under stones, whereas *gilva* very rarely, if ever, does so. The latter species is also more fussy about the position of its nest in the log, preferring to nest in the loose frass under the bark. The size of the colonies varies from a few dozen to several hundred individuals. In the latter case, several deälated queens are usually present. The writer has never seen *solitaria* in the field but in the other two species

the workers are rather sluggish and surprisingly difficult to see when they are foraging. For this reason the collector is seldom aware of the presence of a colony until he has broken into the nest. For a detailed account of the nest activities of *gilva* the reader is referred to a paper published by Haskins in 1931.

The key which follows is essentially that presented by M. R. Smith in his 1934 publication on our species of Euponera.

Key to the species of Euponera

1. Mesonotum surrounded by a distinctly impressed suture, its dorsum blisterlike and rather sharply set off from the pronotum; tibiae of the middle legs long and without stiff hairs on their extensor surfaces; eyes of moderate size, their facets distinct (Subgenus *Brachyponera*) . . . . . *solitaria*
   The suture which surrounds the mesonotum only moderately impressed, dorsum of the mesonotum not strongly convex and not sharply set off from the pronotum; tibiae of the middle legs short and bearing stiff hairs on their extensor surfaces; eyes small, their facets indistinct (Subgenus *Trachymesopus*) 2
2. Length 3–3.4 mm.; color light to dark ferrugineous; the antennal scape failing to reach the median occipital border by an amount which exceeds its greatest thickness; mesopleurae not distinctly striated . . . . . *gilva*
   Length 4.5–4.8 mm.; color very dark brown to black; the antennal scape reaching the median occipital border; mesopleurae distinctly striated . . . . *stigma*

Subgenus BRACHYPONERA Emery

1. EUPONERA (BRACHYPONERA) SOLITARIA (F. Smith)

(Introduced)

Ponera solitaria F. Smith, Trans. Ent. Soc. Lond., p. 404 (1874) ♀; Forel, Mitt. Schweiz Ent. Ges., Vol. 10, p. 267 (1900) ♀ ♀.

E. (*Brachyponera*) *solitaria* Emery, Ann. Soc. Ent. Belg., Vol. 45, p. 47 (1901); Emery, Deutsche Ent. Zeitschr., p. 366, fig. 6 (1909) ♀ ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 22, p. 306, pl. 41, fig. 13 (1906) ♀; M. R. Smith, Ann. Soc. Ent. Amer., Vol. 27, No. 4, p. 559, fig. 1 (1934) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 539, pl. 3, fig. 12 (1947) ♀.

Type loc: Hiogo, Japan. Types: British Museum.

Range: (in the United States) Georgia to Virginia.

This species is endemic to Japan and parts of China. It appears to be well established in one or two areas in the Central Atlantic States.

Subgenus TRACHYMESOPUS Emery

2. EUPONERA (TRACHYMESOPUS) GILVA (Roger)

Ponera gilva Roger, Berl. Ent. Zeitschr., Vol. 7, p. 170 (1863) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 266, pl. 18, fig. 10 (1895) ♀.

Pachycondyla (*Pseudoponera*) *gilva* Emery, Ann. Soc. Ent. Belg., Vol. 45, p. 46 (1901) ♀.

Euponera (*Trachymesopus*) *gilva* Emery, Genera Insectorum, Ponerinae, p. 86 (1910); Wheeler and Gaige, Psyche, Vol. 27, p. 69 (1920) ♀; Creighton and Tulloch, Psyche, Vol. 37, p. 71, fig. 1–3 (1930) ♀ ♀ ♂; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 27, p. 561 (1934) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 539, pl. 4, fig. 13 (1947) ♀.

Euponera (*Trachymesopus*) *gilva* subsp. *harnedi* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 22, p. 543 (1929) ♀.

Type loc: "North America". Types: none in this country.

Range: southeastern States. At present published records are confined to Mississippi, Alabama and Tennessee but it seems certain that *gilva* also occurs in northwestern Florida and southern Georgia.

3. EUPONERA (TRACHYMESOPUS) STIGMA (Fabricius)

(Introduced?)

Formica stigma Fabricius, Syst. Piez., p. 400 (1804) ♀.

Ponera stigma Roger, Verz. Formic., p. 16 (1863); Emery, Ann. Mus. Civ. Genova, Vol. 25, p. 434 (1887) ♀.

Ponera quadridentata Roger, Berl. Ent. Zeitschr., Vol. 4, p. 285 (1860) ♀; F. Smith, Jour. Proc. Linn. Soc. Zool., Vol. 3, p. 143 (1858) ♀.

Ponera americana Mayr, Verh. Zool-bot. Ges. Wien, Vol. 13, p. 722 (1862) ♀.

Pachycondyla (*Pseudoponera*) *stigma* Emery, Ann. Soc. Ent. Belg., Vol. 45, p. 46 (1901).

Euponera (*Pseudoponera*) *stigma* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 398 (1901); Rev. Suisse Zool., Vol. 9, p. 339 (1901).

Euponera (*Trachymesopus*) *stigma* Emery, Genera Insectorum, Ponerinae, p. 85 (1910); M. R. Smith, Ann. Ent. Soc. Amer., Vol. 27, p. 563 (1934) ♀.

Type loc: "Meridional America". Types: none in this country.

Range: widely distributed throughout the Antilles and the tropical portions of North and South America. The records from the United States are confined to southern Florida.

Genus PONERA Latreille

(Plate 8, figures 1–4)

The ants which belong to the genus Ponera present a singularly uniform group as far as their habits are concerned. All of them form

small and rather obscure colonies in rotten wood or soil. They are decidedly timid ants and rarely forage on the surface. As far as is known, all the species feed on insects or other small arthropods. Their distribution is, on the other hand, considerably more interesting. Of the six species which occur in the United States, two range far to the south. Thus *opaciceps* has been taken in Uruguay, and *trigona* subsp. *opacior* in Chile. Both these species are widely distributed in Central and South America and the Antilles. Two other species, *ergatandria* and *inexorata*, are known to occur as far to the south as Costa Rica and one of these (*ergatandria*) is also Antillean. Of the remaining two species *oblongiceps* is known only from type material, hence its range is a matter of conjecture but *coarctata* subsp. *pennsylvanica* does not enter the tropics at all as far as is known. On the contrary, in the southern portion of its range its numbers show a marked decrease. Because of this it has been customary to accord a different faunal relationship to *coarctata*, allying it to the boreal element of our ant fauna rather than to the Neotropical group. But if one considers the extraordinary distribution of *coarctata*, this interpretation is less certain. The typical *coarctata* occurs in Europe where it is largely confined to the Mediterranean basin. There is, however, a subspecies *boerorum* from Natal and another, *mackayensis*, from Queensland. About all that one can say under such circumstances is that *pennsylvanica*, unlike some of the other species of the genus, shows no tendency to utilize the tropical areas to the south of its range.

The genus Ponera possesses a number of species in which the only known male is a wingless individual known as an ergataner. In most respects these so strongly resemble the worker that a rather close inspection is necessary to distinguish the two. The ergataner, in addition to possessing male copulatory organs, is usually a little larger than the worker and sometimes has one more joint in the antennae. Very little is known about the mating of such species, although it is generally assumed that, because of the aptery of the ergataner, it must be between individuals from the same nest.

The North American representatives of the genus Ponera were monographed in 1936 by M. R. Smith. He subsequently described our sixth species, *oblongiceps*. The key below has been expanded to include that species. Otherwise it is as given in Dr. Smith's monograph.

Key to the species of Ponera

1. External border of the mandibles sinuate; base of the epinotum laterally compressed; color ferrugineous yellow ..... *inexorata*
   External border of the mandibles not sinuate 2

2. Petiole when viewed in lateral profile slender, subtriangular (that is narrower dorsally than ventrally) body slender; color varying from light brown to pitch black..... *trigona* subsp. *opacior*
   Petiole when viewed in lateral profile robust, subrectangular (that is approximately as wide dorsally as ventrally).....3
3. Head very finely punctate, shining; eyes extremely small (3–4 facets); color light brownish yellow or dirty brownish yellow; size 2.3–2.9 mm.....4
   Head with coarser punctures, therefore subopaque or opaque; eyes with more than 3–4 facets; color normally brownish black or black; robust; size exceeding 3 mm.....5
4. Antennae of the male (ergataner) twelve-jointed; pubescence distinct but fine..... *ergatandria*
   Antennae of the male (ergataner) thirteen-jointed; pubescence coarser... *oblongiceps*
5. Head with dense, coarse punctures, subopaque..... *coarctata* subsp. *pennsylvanica*
   Head densely but more finely punctate, thus giving the general surface a subopaque appearance, but lacking the coarse granular effect common to *pennsylvanica*..... *opaciceps*

1. Ponera coarctata pennsylvanica Buckley

Ponera pennsylvanica Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 171 (1866) ☿.
Ponera coarctata subsp. *pennsylvanica* Emery, Zool. Jahrb. Syst., Vol. 8, p. 267 (1895) ☿ ♀ ♂; Wheeler, Biol. Bull., Vol. 2, p. 44, figs. 1–4 (1900) ☿ ♀ ♂; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 29, p. 426 (1936) ☿ ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 538, pl. 4, fig. 14 (1947) ☿.
Type loc: Pennsylvania. Types: none known to exist.
Range: eastern United States and Canada.

According to Smith, the range of this insect does not extend west of the 97th degree of longitude. It is most abundant in the northeastern states, the frequency in Canada and the Gulf States being notably less than that in the middle of the range.

2. Ponera ergatandria Forel

Ponera ergatandria Forel, Trans. Ent. Soc. Lond., p. 365 (1893) ☿ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 405 (1908) ☿ ♀ ♂; M. R. Smith, Ann. Soc. Ent. Amer., Vol. 29, p. 425 (1936) ☿ ♀ ♂.
Type loc: Island of St. Vincent, B. W. I. Types: none in this country.
Range: in the United States, Texas and Florida only. Presumably does not occur in the central Gulf States.

3. Ponera inexorata Wheeler

Ponera inexorata Wheeler, Psyche, Vol. 10, p. 94, fig. 2 (1903) ☿ ♀; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 29, p. 422 (1936) ☿ ♀.
Type loc: Austin, Texas. Types: M.C.Z.
Range: in the United States, sporadically distributed in the southern part of the country from Texas eastward to the Carolinas.

By present designation the type series is restricted to the specimens coming from Austin, Texas. Wheeler's original description was based on these specimens as well as others coming from San Angelo and Ft. Davis. Elsewhere in this volume I have shown why such restriction is necessary.

4. Ponera oblongiceps M. R. Smith

Ponera oblongiceps M. R. Smith, Proc. Ent. Soc. Wash., Vol. 41, No. 3, figs 1–3 (1939) ☿ ♀ ♂.
Type loc: Priest Bridge, Maryland. Types: U.S.N.M.
Range: known from type material only.

5. Ponera opaciceps Mayr

Ponera opaciceps Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 536 (1887) ☿ ♀; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 22, p. 545 (1929) ♂; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 29, p. 428 (1936) ☿ ♀ ♂.
Type loc: Province of Sta. Catharina, Brazil. Types: none in this country.
Range: in the United States, southern and southwestern states as far west as Arizona. In the east the insect does not occur north of South Carolina. In the west it has been taken in northern Colorado.

6. Ponera trigona opacior Forel

Ponera trigona var. *opacior* Forel, Trans. Ent. Soc. Lond., p. 363 (1893) ☿ ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 268 (1895) ☿ ♀ ♂; Emery, Mem. Accad. Sc. Bologna, (5), Vol. 5, p. 296 (1895) ♂; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 29, p. 423 (1936) ☿ ♀.
Type loc: Island of St. Vincent, B. W. I. Types: none in this country.
Range: in the United States, extensively distributed in the southern and southwestern states. It has been taken as far north as Ohio and as far west as Oregon but these records are exceptional. The normal northern boundary of its range appears to be about the latitude of southern Virginia. It is scarce west of Texas.

Genus LEPTOGENYS Roger

Subgenus LOBOPELTA Mayr

(Plate 9, figures 1–4)

The distribution of *L.* (*Lobopelta*) *elongata*, the only species of Leptogenys which occurs in the United States, is an interesting one. Several of the older records published for *elongata* have tended to obscure the distributional characteristics of this species. Some of the older records are highly suspect. Records for *elongata* have been reported from Colorado, the District of Columbia and Maryland. It is unlikely, but not impossible, that *elongata* occurs in southeastern Colorado. But the records from the District of Columbia and Maryland seem plainly impossible. After Wheeler's studies of the habits of *elongata* in 1900 and 1904, the prevalence of this species in central Texas was clearly established. But the older records persisted and to them were added others scarcely more trustworthy. As late as 1923, Wheeler published the statement that the range of *elongata* extends from Texas to Georgia. I have been unable to discover the basis on which this statement rests. I have never seen any specimens of *elongata* coming from Georgia and it seems unlikely that the insect occurs there. For many years Dr. M. R. Smith made a very careful study of the ants of Mississippi and for several summers the writer engaged in intensive field work on ants in Alabama. If the range of *elongata* extends from Texas to Georgia it is reasonable to expect that it would occur in both of the states just mentioned. While the insect is rather sporadic, even in its area of greatest abundance, it is certainly not inconspicuous. It seems hard to believe that it would not have been taken in Alabama or Mississippi if it occurs in those two states.

The matter has been further obscured by the presence of the subspecies *manni* in southern Florida. The first Florida records from Bellaire were originally attributed by Wheeler to the typical *elongata*. Later he set up the subspecies *manni* on material taken at Dunedin and Miami. No mention was made of the Bellaire specimens in the original description of *manni* but nine years afterwards these specimens were also attributed to *manni*. Thus during the period from 1923 to 1932, it would have been correct, on the basis of published data, to assume that both *elongata* and *manni* occur in Florida. Actually, the two have widely separated ranges. All the evidence indicates that *manni* is restricted to southern Florida. Except for Wheeler's questionable Georgia record all others for the typical *elongata* come from regions west of the Mississippi River. The most eastern record to date seems to be Beaumont, Texas but the insect almost certainly occurs in Louisiana as well.

Once the above points are clearly in mind, it is possible to appreciate a significant characteristic in the distribution of the typical *elongata*. Unlike many of the Mexican species whose ranges run into Texas, *elongata* does not increase in abundance as one approaches the border. This seems clear from the excellent set of records published by Dr. M. R. Smith in 1936. Except for a single record from Brownsville, all the others were from an area north of the latitude of Matagorda. This area extended from Beaumont west to San Antonio and from Matagorda north to Waco. It would seem, therefore, that the typical *elongata* is less abundant in the Brownsville area (and presumably the adjacent portion of Mexico as well) than in stations further north. We have in *elongata* a northern species with the 'fringes' extending southward, not the reverse. In this respect it would appear to repeat, on a much restricted scale, the same distributional characteristics which mark Stigmatomma. It may also be noted that, while the related species *mexicanum* occurs in Mexico, no allied species occurs in Cuba. The presence of the subspecies *manni* in Florida would, therefore, seem to indicate a previous range which spanned the entire Gulf Coast.

The biology of *elongata* was described in a paper which W. M. Wheeler published in 1900. He was able to show that winged females do not occur in this species. Their place in the colony is taken by the 'gynecoid' worker, a fertile individual in which the abdomen and petiole are slightly larger than those of the ordinary worker. The rather small colonies of *elongata* are built in soil or in rotten logs. According to Wheeler this species feeds largely on wood slaters of the genera Armadillium and Oniscus.

Key to the subspecies of Leptogenys (Lobopelta) elongata Buckley

1. Petiole very distinctly truncated anteriorly; surface of the head and thorax only moderately shining; color light brownish or yellowish red. . . . *elongata*
   Petiole less distinctly truncated anteriorly; surface of the head and thorax more strongly shining; color deep red . . . . . *elongata* subsp. *manni*

1. Leptogenys (Lobopelta) elongata (Buckley)

Ponera elongata Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 172 (1866) ♀.

L. (Lobopelta) elongata Emery, in Wytsman Genera Insectorum, Fasc. 118, p. 105, pl. 3, fig. 13, b, c (1910) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 538, pl. 4, figs. 15, 15a (1947) ♀.

Leptogenys elongata Wheeler, Biol. Bull., Vol. 2, p. 2, fig. 4 (1900) ♀ ♀ ♂; Wheeler, Ibid., Vol. 6, p. 257 (1904).

Lobopelta septentrionalis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 438 (1886) ♀.
Leptogenys septentrionalis Emery, Zool. Jahrb. Syst., Vol. 8, p. 268 (1895) ♀.
? *Ponera texana* Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 170 (1866) ♀.
Type loc: Austin, Texas. Types: none known to exist.
Range: southern Texas from the Louisiana border to Brownsville and as far north as the latitude of Waco.

2. Leptogenys (Lobopelta) elongata manni Wheeler

L. (*Lobopelta*) *elongata* subsp. *manni* Wheeler, Amer. Mus. Novitates, No. 69, p. 14 (1923) ♀.
Type loc: Dunedin, Florida. Types: M.C.Z.
Range: southern Florida.

This subspecies was described from four workers, one taken by Mann at Miami and three by McGregor at Dunedin. As no type designation was made by Wheeler, all four of the specimens could be regarded as types. It is my opinion, however, that the type series should be restricted to the Dunedin specimens. Much confusion has arisen in the past from the practice of extending the type series over material from several stations. There is no justification for such practice and it weakens the position of those who contend that the members of a single nest series, used as the basis for the description of a new form, should all have equal rank as cotypes.

Genus Odontomachus Latreille

(Plate 10, figures 1–5)

The extraordinary mandibular structure of Odontomachus and the unusual habits which are connected with them have attracted much attention. Perhaps for this reason certain noteworthy distributional features of these insects have received less study than they deserve. Particularly is this true of *O. haematoda*, whose distribution is scarcely less remarkable than are its habits. In general, most Ponerine ants do not vary greatly within the species. It is, therefore, only occasionally that one encounters in this subfamily a species comparable to those protean agglomerations so common among the Myrmicinae and Formicinae. But *O. haematoda* is the exception which proves the rule. This insect, with its apparently endless array of infraspecific variants, is in all respects as labile as the most plastic species in either of the two higher subfamilies. Coupled with this is a remarkable distribution through the Antilles and continental America. It is much to be re-

gretted that so little of the range of *haematoda* lies within our borders, for it is not often that one encounters a species so rich in both insular and continental variants and a comparison of these should prove of great interest. Of the forms which occur in the United States, the most abundant is the subspecies *insularis*. This insect is widely distributed in Florida and occurs also in southern Georgia. Dr. M. R. Smith, who monographed our North American forms of *haematoda* in 1939, is of the opinion that it must also occur in southeastern Alabama. This seems entirely logical, although the writer has never been able to take it there or in the portion of Florida which lies between Alabama and the Gulf. It is almost certainly not endemic to the eastern Gulf States, although it may have been brought into some of the ports there. This curious failure of *insularis* to range westward along the Gulf from Florida rather strongly suggests that it has come into Florida from Cuba. There it is widespread and by no means rare. A similar failure to occupy the region along the Gulf Coast marks the western subspecies *clarus*. The range of this insect lies in southwestern Texas, whence it extends southward into Mexico. There appear to be no records of *clarus* from eastern Texas, although there is a single notable record from Louisiana published in Dr. Smith's monograph. Whatever the significance of this record may be, it is certain that *clarus*, unlike *insularis*, is an ant of the semi-desert regions. Its colonies are smaller than those of *insularis*, rarely consisting of more than fifty individuals and it nests by preference in coarse gravelly soil with the nests fully exposed to the sun. Much the same considerations apply to the two subspecies known to occur in southern Arizona. Both form small colonies, usually under stones, in coarse, gravelly soil. But the subspecies *desertorum* nests at lower elevations than does the subspecies *coninodis*, which rarely comes below elevations of 5000 feet in the canyons of the southern Arizona mountains. The two are, therefore, restricted to separate ranges although the stations in which they occur may lie within a few miles of each other. Since the subspecies *clarus* occurs in Mexico, the geographical affinity of the Texas specimens seems clear enough. They must be regarded as coming from the northern portion of a range which extends into northeastern Mexico. The relationship of the other two subspecies is less clear but there is good reason to believe that they are also northern fringes of variants whose main range lies to the south of the border. It seems likely that when more material is available from northern Mexico, particularly from that virtually unworked region south of the Big Bend area, that all three of these subspecies can be related to others which occur further south in Mexico. For it is clear that if we are to find intergrades between the subspecies, we must look for them in the

tropical portions of continental America. The insular variants are too well isolated in most cases to permit intergradation, as are the scattered representatives which occur within our borders. Even though we know less about the relationship of the various forms than might be wished, one thing seems to be certain. In the case of *haematoda* we have a species which has entered the United States from the south along two distinct routes. Moreover, the eastern and western representatives have remained widely separated, although there would seem to be no particular obstacle to the western spread of *insularis* along the Gulf Coast. This curious situation offers engaging possibilities to those interested in speciation and geographical distribution.

The classical account of the habits of *haematoda* is that which was published by W. M. Wheeler in 1900. This widely quoted study was based upon field observations and also upon the examination of colonies in artificial nests. As a result, Wheeler was able to clear up several points which had puzzled earlier students, who had access only to cabinet specimens. Wheeler showed that the long hairs, which arise between the bases of the mandibles and point forward, act as triggers when the mandibles are open. When these hairs are touched the mandibles snap shut. As to what happens next depends largely upon what the mandibles close on. If the object closed on is small and not too hard it is usually cut in two, very much as a wire is cut by side-cutting pliers. Small insects which fall afoul of Odontomachus are, therefore, apt to have their appendages cut away in short order. But if the object closed upon is too large to be included in the grasp of the closing jaws and, more particularly, if it is hard enough to let the tips of the jaws slide over it, the ant is thrown through a series of backward somersaults by the force of its closing mandibles. In either case there is a distinct click produced when the jaws snap shut. Wheeler claimed that the insects always land on their feet 'like a cat' at the end of the leap but this is not invariably the case. They do, however, get on their feet as soon as they land and, since the leap is too rapid for the eye to follow easily, unless one is looking directly at them as they land, it is easy to get the impression that they land right-side-up. A further point in Wheeler's account has made for misunderstanding. He fed his captive colonies on flies, which were promptly dismembered and ultimately cut to pieces. He compared the attack of the Odontomachus workers to that of hungry dogs and gave a vivid picture of the celerity with which the victim was dispatched. Out of this appears to have grown a popular belief that Odontomachus is an exceptionally ferocious ant. The writer has seen several accounts, intended for general reading, that were little short of hair-raising. Certainly no one who has studied this insect in the field would subscribe

to any such view. The colonies of *insularis, clarus* and *coninodis* which the writer has found have been much more interested in scrambling to safety than in defending the nest. I would regard *haematoda* as a rather timid ant. It may be admitted that when these ants attack other insects the results are spectacular but this is due to their peculiar mandibular structure and not a result of inherent savagery.

The key presented below is essentially that given by Dr. M. R. Smith in his 1939 monograph.

Key to the subspecies of Odontomachus haematoda Linné

1. Posterior third or more of the prothoracic disc with distinct longitudinal striae; color ranging from brown to deep, brownish black.....*insularis*
   Posterior third of the prothoracic disc with distinct transverse striae; color lighter, pale yellowish brown to dark reddish brown.....2
2. Petiolar node conical, without a well-marked spine; color pale yellowish brown.....*coninodis*
   Petiolar node with a distinct, acuminate spine; color reddish brown.....3
3. Length 9–10 mm.; color very dark reddish brown; head of the larger workers with distinct posterior ocellar pits, usually with an erect hair near each pit.....*desertorum*
   Length 7–8 mm.; color light reddish brown; posterior ocellar pits indistinct or absent.....*clarus*

1. Odontomachus haematoda clarus Roger

O clarus Roger, Berl. Ent. Zeitschr., Vol. 5, p. 81 (1861) ♀; Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 124 (1901) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 407 (1908) ♀ ♀ ♂.

O. haematoda subsp. *clarus* Emery, in Wytsman Genera Insectorum, Fasc. 118, p. 115 (1910); M. R. Smith, Jour. N. Y. Ent. Soc., Vol. 47, p. 129 (1939) ♀.

O. texanus Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 335 (1867) ♀.

O. haematodes Wheeler, Biol. Bull., Vol. 2, p. 2, figs. 1, 5, 6 (1900).

Type loc: Texas. Types: none in this country.

Range: southwestern Texas and northeastern Mexico.

2. Odontomachus haematoda coninodis Wheeler

O. haematoda subsp. *coninodis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 391 (1915) ♀ ♀; M. R. Smith, Jour. N. Y. Ent. Soc., Vol. 47, p. 128 (1939) ♀.

Type loc: Miller and Ramsey Canyons, Huachuca Mountains, Arizona.

Types: M.C.Z., Coll. W. S. Creighton.

Range: known only from the type locality.

3. Odontomachus haematoda desertorum Wheeler

O. haematoda subsp. *desertorum* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 391 (1915) ♀; M. R. Smith, Jour. N. Y. Ent. Soc., Vol. 47, p. 128 (1939) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 538, pl. 4, figs. 16, 16a (1947) ♀.

Type loc: Carnegie Desert Laboratory, Tucson, Arizona.

Types: M.C.Z.

Range: deserts of southern Arizona.

4. Odontomachus haematoda insularis Guérin

O. insularis Guèrin, Icon. Regne Animal, Ins. Vol. 7, p. 423 (1845) ♀; Lucas, in Ramon Hist. Fis. Cuba, Vol. 7, p. 757, pl. 18, fig. 7 (1857) ♀ ♀ ♂.

O. haematoda subsp. *insularis* Emery, Bull. Soc. Ent. Ital., Vol. 22, p. 44 (1890); M. R. Smith, Jour. N. Y. Ent. Soc., Vol. 47, p. 127 (1939) ♀.

Type loc: Cuba. Types: none in this country.

Range: Cuba, Florida and southern Georgia. Distributed by commerce through many parts of the tropics.

Subfamily CERAPACHYINAE

The very limited part which the Cerapachyinae play in our ant fauna scarcely justifies an extensive consideration of this subfamily. There are, however, certain features which ought to be considered, for the status of the Cerapachyinae is different from that of any other subfamily of ants. In delimiting the subfamily Cerapachyinae in 1920, Wheeler was forced to use a combination of characters, none of which are definitive in themselves. Some of these characters are shown by the Ponerinae, others by the Dorylinae. The recognition of the Cerapachyinae rests upon the fact that no other group combines these characters. This blending of ponerine and doryline traits had been recognized many years earlier by Emery and Forel but Wheeler was able to augment their observations by additional information concerning the structure of the larvae and the activities of the workers. His studies supported Emery's contentions that the cerapachyine genera are a link between the Ponerinae and Dorylinae. The larvae of the Cerapachyinae are, so far as is known, very similar to those of the Dorylinae. The habit of the eyeless workers of raiding the nests of other ants for food certainly suggests doryline affinities. The structure of the sexual forms is decidedly transitional. The female may be winged and very similar to the female of certain ponerine genera, or apterous and ergatoid (again a ponerine trait) or dichthadiiform as in the Dorylinae. The males appear to be more uniform in

structure but still manage to combine the characteristics of the two other subfamilies. Their general appearance is very much like that of the ponerine male but they lack cerci, possess a deeply furcate subgenital lamina and have retractible genital armature. These last three traits are rare in the ponerine male but common in the males of the Dorylinae.

While Wheeler's proposal to treat the Cerapachyinae as a subfamily is preferable to the attempt to force this group of genera into the Ponerinae or Dorylinae, it by no means solves certain taxonomic difficulties inherent in the subfamily. Because there are no distinctive subfamily characteristics in the Cerapachyinae it is necessary to employ tribal or generic criteria for their recognition. It is interesting to note that in the generic key which Wheeler published in 1922, no attempt was made to separate the Cerapachyinae from the Ponerinae either in the key to the subfamilies or that of the tribes of the Ponerinae. While the joint key was said to be a matter of convenience it would be much more convenient if the Cerapachyinae possessed good subfamily characteristics. Until these are discovered it is not possible to arrive at any altogether satisfactory method for handling this difficult group.

Key to the Genera of the Subfamily Cerapachyinae

1. Antennae of eleven segments; antennal scape not flattened; antennal fossa bordered laterally by a distinct carina; frontal carinae not expanded laterally, the antennal insertions fully exposed..... *Cerapachys*
   Antennae with twelve segments; antennal scape much flattened over its entire length; antennal fossa not bordered laterally by a carina; frontal carinae somewhat expanded laterally and largely concealing the insertions of the antennae..... *Acanthostichus*

Genus CERAPACHYS F. Smith

Subgenus PARASYSCIA Emery

(Plate 11, figures 1–2)

The majority of the species which belong to Cerapachys are found in the tropics of the Old World. The two species which occur within our borders both belong to the subgenus Parasyscia and are both confined to the states of the southwest. The two species are rare and very little is known about their habits. Wheeler was able to make a few observations on the type colony of *augustae*, which he took at

Austin, Texas. The nest was about six inches below the surface of soil containing limestone chips. In the nest were ten workers and a female. Wheeler was of the opinion that this represented most if not all of the colony. The insects crept about slowly with the antennal scapes thrust forward in a peculiar fashion. Wheeler inferred that these ants lead a subterranean existence. The fact that they are eyeless would certainly favor such a view. It is virtually certain that these ants are carnivorous and it is probable that they are predaceous. We badly need more information on the habits of our two species.

1. Cerapachys (Parasyscia) augustae Wheeler

C. (*Parasyscia*) *augustae* Wheeler, Bio. Bull., Vol. 3, p. 182, figs. 1, 2 (1902) ♀ ♀; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 44, No. 4, p. 63 (1942) ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 526, pl. 1, fig. 3 (1947) ♀.

Type loc: Austin, Texas. Types: M.C.Z.

Range: western Texas to southern Arizona.

2. Cerapachys (Parasyscia) davisi M. R. Smith

C. (*Parasyscia*) *davisi* M. R. Smith, Proc. Ent. Soc. Wash., Vol. 44, p. 64 (1942) ♂.

Type loc: Ft. Jeff Davis, Texas. Type and paratypes: U.S.N.M.

Range: known only from type material.

As Dr. Smith notes, the male of *davisi* is larger (3.8 mm.) than that of *augustae* and has the head more rounded behind. In the male of *davisi* all the segments of the antennal funiculus, except the first, are distinctly longer than broad. The sides of the thorax and the area between the inner border of the eye are delicately rugulose in *davisi*. It is to be hoped that workers and females of this interesting species will soon be discovered, for its exact relationship to *augustae* is problematical as long as the other two castes remain unknown.

Genus Acanthostichus Mayr

Subgenus Ctenopyga Ashmead

The two North American species belonging to Acanthostichus have been placed in the subgenus Ctenopyga. The relationships of Ctenopyga are far from clear. It was originally described as a genus by

Ashmead in 1906. It contained the single species, *townsendi*, based upon male and female specimens taken in Mexico. Later Emery made Ctenopyga a subgenus of Acanthostichus and added to it the species *texanus*, which Forel had described in 1904. This species was also described from a female. Since no additional specimens appear to have been taken, the characteristics of the worker remain unknown except as they may be inferred from the structure of the female. Emery believed that it is possible to separate Ctenopyga from Acanthostichus because the female of the first group is winged while that of the latter is apterous and resembles a dichthadiigyne. He may be correct in this contention but it seems well to point out that there is only one species of Acanthostichus, *A. quadratus*, in which the female is known. The others are based upon the worker or the male. It is by no means certain that the female of Acanthostichus is always apterous or that of Ctenopyga always winged. In this connection it is interesting to note that the female from which *texanus* was described lacked wings. Emery was evidently of the opinion that it had once possessed them but this is by no means certain from Forel's description. There is little to be gained by such speculations, however, for it is obvious that no satisfactory conclusion as to the relationship of Ctenopyga to Acanthostichus can be reached until both groups are much better known.

1. Acanthostichus (Ctenopyga) texanus Forel

A. texanus Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 168 (1904) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 400 (1908) ♀.

A. (*Ctenopyga*) *texanus* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 526, pl. 1, fig. 4 (1947) ♀.

Type loc: Brownsville, Texas. Types: none in this country.

Range: known from southwestern Texas only.

Subfamily DORYLINAE

The ants which belong to the Subfamily Dorylinae are unique in so many respects that it is difficult to treat them in the same fashion as the members of the other subfamilies. The doryline male is so unlike that of most ants that for a very long while it was not recognized as an ant at all. This circumstance has caused an unusual amount of complication in the taxonomy of the group, for many of the species have been described from the male only and it is usually quite impossible to associate such males with their proper workers unless one is lucky enough to find the two castes together in one colony. In

addition, the group possesses a most unusual type of female called a dichthadiigyne. This strange creature is a sort of oversized worker with a very voluminous gaster which on occasion becomes greatly distended with eggs. The dichthadiigyne has a worker type of thorax and never possesses wings, hence there is good reason to suppose that she usually mates with males of the same colony.

These considerations, however, are not what has attracted attention to the doryline ants. The African 'drivers' and the New World 'army' ants are widely known because of their spectacular foraging habits. At certain seasons these insects become nomadic and the entire colony sets out on an expedition which becomes a series of raids against any animal that may happen to be in the vicinity. Since some of the species form large colonies and possess a large soldier caste with powerful jaws, the raids are not to be taken lightly, although there has been much exaggeration of the capacity of these insects for attacking large vertebrates. Undoubtedly they would do so if given the opportunity but unless the animal were badly crippled or comatose it could easily avoid the attack. The main victims of these raids are other insects which are secured in prodigious numbers.

Although the raids of the dorylines have been repeatedly studied and described, the basis for them was not clearly understood until the last few years. In 1941 Schneirla began the publication of his illuminating studies on the behavior of Eciton colonies. Most of his studies have dealt with species which do not occur within the limits of the United States, but his work is of such importance that it may be cited as a model for those who care to undertake similar observations on our species.

Schneirla established the fact that the Eciton colony passes through an alternation of statary and nomadic phases. In the statary phase the colony has a fixed bivouac which is often in a hollow log or tree trunk. From this 'nest' a certain amount of raiding goes on but this by no means involves the movement of the whole colony. During the statary period much brood is present and as the older brood approaches the pupal stage the raids diminish. When most of the older brood has pupated the raids may cease altogether. But with the emergence of the callows the colony becomes very active and when most of them have emerged another nomadic phase is inaugurated, with the colony moving from place to place and setting up temporary bivouacs as the occasion demands. The brood present in the nest at this time has come from eggs laid during the foregoing statary period. It should be clear from the above that the Eciton female has periodic bursts of egg-laying activity. Schneirla has shown that this is the case and that when the female is actively engaged in laying eggs she becomes notably

physogastric, with the abdominal segments forced apart by the mass of eggs within. The activity of an Eciton colony can, therefore, be explained as due to the reproductive behavior of the female. The nomadic phase corresponds roughly to her period of reduced sexual activity. The statary phase follows after the onset of a new period of marked sexual activity.

As already noted these observations have been mainly made upon tropical species of Eciton. It remains to be seen how they will apply to our species of Neivamyrmex. It will undoubtedly be much more difficult to make the requisite observations on Neivamyrmex, for they are very difficult insects to observe in the field. The colonies are seldom large and their activities are remarkably obscure. Several of the species appear to be largely subterranean in their habits. If one may judge from Schneirla's work with Eciton, however, the results which might be secured would amply repay the trouble they might entail.

Genus ECITON Latreille

(Plate 12, figures 1–4)

All the representatives of Eciton which occur in the United States belong to the subgenus Labidus or to the subgenus Neivamyrmex. The workers of the two subgenera may be separated as follows:

Key to the Subgenera of Eciton

1. Tarsal claw with a median tooth ..... *Labidus*
   Tarsal claw simple, without a median tooth ..... *Neivamyrmex*

Subgenus LABIDUS Jurine

The subgenus Labidus is represented in the United States by three species, *coecum, crassicorne* and *esenbecki*. The first insect is widely distributed in southern Texas. It is by no means an obscure ant and has frequently been observed in the field. According to Wheeler and Long (1901), *coecum* constructs brood chambers beneath stones and is 'entirely subterranean'. This observation needs qualification for *coecum*, like many other species of Eciton, will forage above ground when the circumstances are suitable. In the vicinity of Austin, where Wheeler made most of his studies, it might be expected that *coecum* would make nocturnal or crepuscular forays. Many species of Eciton will avoid full sunlight whenever possible. Wheeler states (1908) that *coecum* will feed on practically anything of an edible nature but it

seems clear that most of the food eaten has a high protein content. Living and dead insects form the main part of the diet but this species has also been observed to feed on carrion and the kernels of various nuts.

Since the male of *esenbecki* has never been associated with a worker, the following key deals only with *coecum* and *crassicorne*.

Key to the species of Labidus (workers)

1. Inner border of the mandible with a large, sharp, triangular, central tooth ..... *coecum*
   Inner border of the mandible with a long, low, flattened projection at the middle ..... *crassicorne*

Before presenting the very extensive synonymy of *coecum* I wish to explain the arrangement followed. In most cases where a reasonably constant nomenclature has been followed it is possible to reduce the number of the citations by eliminating those which contain nothing of particular value to the investigator. This is not feasible in the case of *coecum*. It would be difficult to say how many references to this species exist in the literature. During the last century and a half it has been assigned to seven different genera and described under at least fourteen different specific names. Since the synonymy should contain at least one reference to each of the names employed, it follows that even the minimum listing will be a lengthy one. But if the list is presented chronologically, a number of the older references, which have virtually no value, are given a prominence which they do not merit. I have, therefore, divided the synonymy into three sections. In the first, in addition to the original description, are references dating from 1886. In that year Mayr recognized Latreille's *Formica coecum* as an Eciton. All references in the first group, except the original description will, therefore, carry present-day generic and specific designations. The second group consists of a chronologically arranged list of references in which the generic name, the specific name, or both, may differ from present usage. Finally, there is the list of doubtful references which are believed to apply to *coecum*. For most purposes only the first group of references need be consulted and this arrangement will, I trust, save much effort.

1. Eciton (Labidus) coecum (Latreille)

Formica coeca Latreille, Fourmis, p. 270, pl. 9, fig. 56 (1802) ♀.

Eciton coecum Mayr, Wien Ent. Zeit., Vol. 5, p. 119 (1886) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 553 (1887) ♀; E. André, in Forel, Biol.

Centrali Amer., Vol. 3, p. 160 (1900) ♀; Emery, Mem. Accad. Sci. Bologna (5), Vol. 8, p. 517 (1900) ♀ ♂; Wheeler & Long, Amer. Naturalist, Vol. 35, p. 166, fig. 2c (1901) ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 408, pl. 26, fig. 3 (1908) ♂.

E. (*Labidus*) *coecum* Emery, in Wytsman Genera Insectorum, Fasc. 102, pl. 1, fig. 3 (1910) ♀; Weber, Amer. Mid. Naturalist, Vol. 26, No. 2, p. 327, figs. 1–6 (1941) ♀ ♀; M. R. Smith, Ibid., Vol. 37, No. 3, p. 526, pl. 1, fig. 1 (1947) ♀.

Labidus latreillei Jurine, Nouv. Meth. Class. Hym., p. 283 (1807) ♂.

Labidus jurinei Shuckard, Ann. Nat. Hist., Vol. 5, No. 2, p. 198 (1840) ♂.

Labidus sayi Haldeman, Stansbury's Exp. Great Salt Lake, Lippincott Grambo & Co., p. 366 (1852) ♂.

Labidus atriceps F. Smith, Cat. Hym. Brit. Mus., Vol. 7, p. 5, pl. 2, fig. 4 (1859) ♂.

Eciton vastator F. Smith, Jour. Ent. Soc., Vol. 1, p. 71 (1860) ♀.

Eciton erratica F. Smith, Ibid., p. 71 (1860) ♀.

Nycteresia coeca Roger, Berl. Ent. Zeitschr., Vol. 5, p. 22 (1861) ♀.

Myrmica rubra Buckley, Proc. Ent. Soc. Phila., p. 335 (1866) ♀.

Pseudodichthadia incerta E. André, Spec. Hym. Europe, Vol. 2, Supl. p. 8, fig. 1–5 (1885) ♀.

Eciton jurinei Mayr, Wien Ent. Zeit., Vol. 5, p. 33 (1886) ♂.

Eciton omnivorum Emery, Bull. Soc. Ent. Ital., Vol. 33, p. 163 (1891) ♀; Emery, Ibid., Vol. 26, p. 179, pl. 2, fig. 9 (1894) ♀ ♀ ♂.

Mutilla (*Labidus*) *fulvescens* Blanchard in Cuvier Regné Animal Ins. (Ed. 3), Vol. 2, pl. 118, fig. 2 (1894) ♂.

Eciton selysi Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 169 (1904) ♀.

? *Formica omnivora* Olivier, Encycl. Meth. Ins., Vol. 4, p. 496 (1791) ♀.

? *Labidus pilosus* F. Smith, Cat. Hym. Brit. Mus., Vol. 7, p. 7 (1859) ♂.

?*Eciton smithi* Dalla Torre, Wien Ent. Zeit., Vol. 21, p. 89 (1892) ♂.

Type loc: "Meridional America". Types: none in this country.

Range: Texas south to Argentina.

2. Eciton (Labidus) crassicorne F. Smith

E. crassicorne F. Smith, Trans. Ent. Soc. Lond. (2), Vol. 3, p. 163, pl. 13, figs. 1, 2 (1855) ♀; F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 151, pl. 6, figs. 1–4 (1858); Mayr, Novara Reise Formic., p. 77 (1865) ♀; Mayr, Wien Ent. Zeit., Vol. 5, p. 115 (1885); Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 179, pl. 2, fig. 8 (1894) ♀; Forel, Biol. Centrali Amer. Hym., Vol. 3, p. 25 (1899).

E. (*Labidus*) *crassicorne* Emery, in Wytsman Genera Insectorum, Fasc. 102, p. 23 (1910).

Type loc: Villa Nova, Brazil. Types: British Museum.

Range: southern Texas to Paraguay.

I have seen no specimens of *crassicorne* coming from the United States but Dr. M. R. Smith assures me that workers of this species

have been taken at Brownsville, Texas. In all probability, even this southern station is north of the usual range of *crassicorne*. It is certainly not abundant in the region around Brownsville and there is little indication that it has established itself in that area. This is, however, a very difficult matter to determine in the case of an Eciton. Hence it seems better to include *crassicorne* even though it may be a visitor rather than an established resident within our borders.

3. Eciton (Labidus) esenbecki (Westwood)

Labidus esenbecki Westwood, Arc. Ent., Vol. 1, p. 75, pl. 20, fig. 4 (1842) ♂.
Eciton esenbecki Emery, Bull. Soc. Ent. Ital., Vol. 22, p. 39 (1890) ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 409, pl. 26, figs. 1, 2 (1908) ♂.
E. (*Labidus*) *esenbecki* Emery in Wytsman Genera Insectorum, Fasc. 102, p. 23 (1910).
Type loc: Rio Vendinha, Brazil. Types: none in this country.
Range: southern Texas to Brazil.

There appears to be only one record for *esenbecki* in the United States. Wheeler had a single specimen secured near Brownsville prior to 1908. It has been conjectured that *esenbecki* is the male of *crassicorne* and the recent discovery of workers of the latter species in the Brownsville area certainly favors this view. But it is not likely that this problem will be settled by studies on our ant fauna, since both *esenbecki* and *crassicorne* are so rarely encountered in the United States. The differences which separate the male of *esenbecki* from that of *coecum* are given in the following key. The male of *crassicorne* is at present unknown.

Key to the species of Labidus (males)

1. Anterior edge of the clypeus broadly and deeply concave; mandibles slender and rather suddenly bent inward in their distal third..... *esenbecki*
   Anterior edge of the clypeus straight or at most with a narrow and feeble concavity at the center; mandibles stouter and evenly curved throughout *coecum*

If it can be shown that *esenbecki* is the male of *crassicorne*, the first name will take precedence for Westwood's description has a priority of thirteen years over that of Smith.

Subgenus Neivamyrmex Borgmeier

The subgenus Neivamyrmex, which occurs widely in the New World, is the only doryline group well represented in the United States.

Although one species, *nigrescens*, occurs as far north as Illinois, Iowa and Nebraska, the distribution of our species is mainly southern. Many of them have ranges which extend into Mexico and Central America and one or two range into South America. The frequency of occurrence of the individual species and the number of species present in an area show an interesting divergence. The greatest concentration of species is found in a region comprising Texas, Oklahoma, New Mexico and Arizona. In this area more than a dozen species occur. But the incidence of the three or four species which occur in the southeastern states is considerably higher than that of the typically western species. Even the ubiquitous *nigrescens*, which occurs in both areas, seems definitely more abundant in the east. I have observed this same phenomenon in the field. It is usually rather difficult to find colonies of Neivamyrmex from the Pecos River in Texas west to the Pacific Coast. But in the southeastern states and along the Gulf Coast these insects are commonly encountered. This is a somewhat singular behavior for a group whose affinities are so clearly Neotropical, for one would expect that areas of greatest incidence would be close to the southern border of the United States. The explanation rests, I believe, on the assumption that the group is not notably xerophilous. This view can be supported despite western records from stations that are clearly in desert country. For the larger number of western records come from canyons in the foothills of mountains and it is only in such stations that the insects appear to be at all abundant in the west. This results in a much more sporadic distribution in Arizona, New Mexico and western Texas than that which marks the species in the southeastern states. There is a further possibility that the arid climate of the western states forces the species which occur there to adopt a more completely subterranean life. If, as seems likely, many of the western species forage above ground only at night, this circumstance would certainly tend to keep them out of the hands of collectors.

Relatively little is known of the habits of our representatives of Neivamyrmex. The species are said to construct nests and it seems to be generally assumed that these are comparable to the nests of most ants. It is likely, however, that the principal basis for this view is the fact that most of our species of Neivamyrmex utilize chambers in soil under stones, etc. It is not clear that they build these chambers nor is it certain that they occupy them for any protracted period. In 1901 Wheeler and Long presented an account of a nest of *nigrescens* (*schmitti*) which they discovered. In this nest the chambers contained much brood of *nigrescens* and a quantity of brood which had been pilfered from other ant colonies. It may be noted that there is nothing in the above account that would clash with the view that what

Wheeler and Long discovered was a statary phase of *nigrescens* and that the 'nest' was actually a permanent bivouac made during the period when the brood was about to pupate. The foraging activities of Neivamyrmex are much less spectacular than those of the species of Eciton *sens str.* As far as the writer has been able to observe the foraging workers never form a compact column but run rapidly over the ground strung out in a single line. While thus engaged the workers constantly explore the ground ahead of them with the antennae which are twitched with a characteristic flicking motion. In all probability they are following a scent trail laid down by previous workers. Schneirla has demonstrated the importance of such scent trails in the foraging activities of some of the species of Eciton. The food secured by Neivamyrmex appears to consist mainly of other insects. According to Wheeler and Long (*vide supra*) this is brought into the nest and stored for a time before being eaten. If the nest site is changed this stored food is moved to the new site. Nothing is known as to the mating reactions of these insects and the only observation of any sort in this connection appears to be that published by Dr. M. R. Smith in 1942. He reports that D. E. Read took a male and female of *carolinense* in copula. Since this pair was in the nest when secured the presumption is that mating takes place between brothers and sisters of the same colony. Dr. Smith believes that daughter colonies are probably formed by migration.

Of the keys which follow those for the identification of the males and females have been taken directly from Dr. M. R. Smith's 1942 monograph of Neivamyrmex. The key to the workers is also based largely on the separatory characters which were given in the above monograph but the order in which they are presented has been altered and certain minor changes have been introduced. It may be added that anyone interested in the taxonomy of Neivamyrmex should certainly secure a copy of Dr. Smith's monograph for it is, by a very wide margin, the most satisfactory treatment of our species.

Key to the major workers of Neivamyrmex

1. Entire upper surface of the head completely opaque, evenly covered with fine, contiguous punctures and with larger shallow depressions (also punctate) from which the erect hairs arise ..... *nigrescens*
   Upper surface of the head entirely or in large part shining, the surface between the piligerous punctures without sculpture over much of the head 2
2. Anterior peduncle of the petiole with a long, sharp, slender spine which is directed downward and to the rear and is attached to the base of the peduncle by a transparent lamella ..... *pilosum*

Anterior peduncle of the petiole without such a spine, at most with a short anterior tooth, angle or projection which is directed downward or slightly forward 3

3. Node of the petiole in profile subtriangular, with a distinctly rounded crest and an anterior face which slopes gradually to the peduncle; sides of the epinotum abruptly compressed in its upper half. . . *melanocephalum*
Node of the petiole in profile subrectangular, elongate, flat or feebly convex above and with the anterior face abruptly descending to the peduncle; sides of the epinotum feebly or not at all compressed in their upper half. . 4
4. Petiole from above almost twice as long as broad, slender and not subquadrate 5
Petiole from above as broad as long or if a little longer than broad it is robust and subquadrate 6
5. Entire dorsum of the thorax densely sculptured and opaque, only the propleurae shining ..... *opacithorax*
Promesonotum and propleurae feebly to strongly shining . . . *californicum*
6. Frontal lobes high, thin, flange-like and carried part way around the front of the antennal socket as a transparent lamina which projects a little beyond the edge of the clypeus 7
Frontal lobes low, not notably flange-like and, if carried part way round the front of the antennal socket, the rim is low, not transparent and does not project beyond the edge of the clypeus 8
7. Occipital angles very pronounced and ear-like, often reflected outward; eyes distinct; pronotum often subopaque with coarse punctures, rugae and shagreening; length of largest worker 4.5 mm. ..... *wheeleri*
Occipital angles blunt; eyes absent; pronotum smooth and shining with fine punctures only; length of largest worker 3 mm. ..... *leonardi*
8. Head (mandibles excluded) approximately one and one third times longer than broad; gaster distinctly flattened; length of largest worker 2 mm. *pauxillum*
Head (mandibles excluded) approximately one and one eighth times longer than broad; gaster not flattened; length of largest worker at least 3.5 mm. 9
9. Dorsum of the thorax very smooth and shining, punctate only; antennal scape slightly more than two and one half times as long as it is thick at the tip; funicular joints 2–6 notably broader than long . . . . . *commutatum*
Dorsum of the thorax heavily sculptured, subopaque; antennal scape about three and one half times as long as it is thick at the tip; funicular joints 2–6 only a little wider than long ..... *carolinense*

As Dr. Smith has pointed out, there is a strong possibility that *leonardi* and *pauxillum* have been described from minor workers. If this should subsequently prove to be the case it may be necessary to modify the criteria used to distinguish these two species, although neither of them has been brought out on the basis of size only.

Key to the females of Neivamyrmex (M. R. Smith, 1942)

1. Head from above with the posterior corners not produced or indistinctly produced 2
   Head from above with the posterior corners very distinctly produced, angulate or tuberculate 3
2. Thorax more heavily sculptured and opaque than head; thorax elongate, gradually and perceptibly widening anteroposteriorly; prothorax submargined laterally; posterior corners of the head scarcely produced ..... *opacithorax*
   Body smooth and shining with scattered punctures; thorax proportionally wider and with the posterior part of the epinotum subequal in width to the metanotum; prothorax more convex and scarcely, if at all, marginate; posterior corners of the head not produced, broadly rounded ... *carolinense*
3. Head with a distinct median impression near the occiput and an impression on each lateral border which causes the posterior corners to appear distinctly angulate or tuberculate; prothorax clearly margined; thorax elongate, gradually widening anteroposteriorly to the metanotum; head and thorax subopaque or opaque, owing to the dense and rather coarse sculpturing ..... *nigrescens*
   Head with angular posterior corners but lacking the distinct lateral impressions of *nigrescens*; prothorax not margined; thorax, though elongate, of almost uniform width from posterior half of mesonotum backward; head thorax and remainder of body shining even though scattered and distinct punctures on the former two ..... *wheeleri*

Key to the males of Neivamyrmex (M. R. Smith, 1942)

1. Epinotum with a clearly defined, median, longitudinal groove where base and declivity meet; dorsum of head behind ocelli smooth, shining, concave and with distinct, upturned occipital flange 2
   Epinotum without a median longitudinal groove where base and declivity meet or else with a very weakly developed one; occipital flange either absent or vestigial 3
2. Superior border of mandible with an excision near base and apex and between these a somewhat toothlike convexity or protuberance; antennal scape approximately as long as the combined length of the first 4 funicular segments; body and wings of a general yellowish brown color with head, legs and seventh gastric sternum darker ..... *pilosum*
   With similar characters except that the mandible is more robust and the toothlike convexity of the superior border is hardly discernible ..... *pilosum* subsp. *mandibulare*
3. Mandibles sickle-shaped 4
   Mandibles not sickle-shaped 9
4. Head, viewed anteriorly, with strongly projecting posterior corners which are visible between the eyes and the lateral ocelli 5

Head, viewed anteriorly, without posterior corners as described above; either the corners are weakly visible or else not visible 6

5. Wings deeply infumated; mandibles extremely long, slender and curved; posterior corners of the head remarkably well-developed; dorsal surface of the gaster with short, appressed hairs ..... *fuscipennis*
Wings not infumated; mandibles, though slender and curved, not extremely long; posterior corners of the head less well-developed; dorsal surface of the gaster with long, non-appressed hairs ..... *melsheimeri*
6. Small, slender species, length 8–9 mm 7
Large species, length 11–13 mm 8
7. Lateral ocelli borne on an elevated area which is distinctly above the level of the rest of the head; third funicular segment almost twice as long as the second, the latter notably broader than long ..... *minus*
Lateral ocelli not raised much above the level of the rest of the head; third funicular segment less than one and a half times as long as the second, the latter approximately as broad as long ..... *mojave*
8. Antenna with a long, filiform funiculus; scape not noticeably wider than the base of the funiculus; head, from above, not remarkably broader than long; tarsal claws indistinctly toothed ..... *oslari*
Antennal funiculus not long and filiform, distinctly tapering from base to apex; scape robust, distinctly broader than the base of the funiculus; head, from above, remarkably broader than long; tarsal claws distinctly toothed *arizonense*
9. Head with unusually large eyes and ocelli; ocelli placed on a protuberance high above the general surface of the head; body deep brown with darker head and thorax ..... *harrisii*
Head with small eyes and ocelli; ocelli placed on a low protuberance which is scarcely elevated above the general surface of the head; color variable but never as described above 10
10. From above, the dorsal surface of the head rounding off anteriorly without forming a very perceptible ridge above the antennal sockets; dorsal surface of the head and thorax, although sculptured, with a distinct glabrous appearance ..... *opacithorax*
From above, the dorsal surface of the head forming distinct ridges above the antennal sockets; dorsal surface of the thorax with a subopaque or opaque appearance 11
11. Mandible remarkably long and slender, at least five times as long as broad; funiculus slender; length 9–9.5 mm ..... *carolinense*
Mandible more robust, not so remarkably long and slender, funiculus robust; length 11–13 mm ..... *nigrescens*

4. Eciton (Neivamyrmex) arizonense Wheeler

E. (*Acamatus*) *arizonense* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 414, pl. 26, fig. 5 (1908) ♂.

E. (*Neivamyrmex*) *arizonense* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 581, pl. 5, fig. 19 (1942) ♂.

Type loc: Nogales, Arizona (by Smith's 1942 restriction),
Types: M.C.Z.
Range: western Texas to southern Arizona and south to Costa Rica.

5. Eciton (Neivamyrmex) californicum Mayr

E. californicum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 969 (1870) ♀.
E. (*Labidus*) *californicum* Mayr, Wien Ent. Zeitschr., Vol. 5, No. 14, p. 121 (1886) ♀.
E. (*Acamatus*) *californicum* Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 184 (1894) ♀; Emery, Mem. Accad. Sci. Bolgna (5) Vol. 8, p. 523 (1900) ♀.
E. (*Neivamyrmex*) *californicum* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 560 (1942) ♀.
Type loc: San Francisco, California. Types: none in this country.
Range: known from California only.

Our present knowledge is decidedly limited as to the biology of *californicum*, for the species has been taken on comparatively few occasions. This circumstance makes any prediction about this insect a rather risky matter. I would, however, venture the opinion that when *californicum* is better known it may be necessary to synonymize *opacithorax* with *californicum*. It may be recalled that *opacithorax* was originally described as a subspecies of *californicum*. Because of its much greater abundance, *opacithorax* is now far better known than is *californicum* and this fact has tended to obscure the relationship between the two insects. As its name indicates, *opacithorax* was originally separated from *californicum* because of its more extensively sculptured and more opaque thorax. Recently Dr. Smith has stated that *californicum* is more hairy than *opacithorax*. As regards this last point I cannot agree at all with Dr. Smith for *opacithorax* is often very hairy with the curious mixture of short and very long hairs which Dr. Smith describes as characteristic of *californicum*. Nor do I believe that much reliance can be placed in the differences of thoracic sculpture which are supposed to separate the two forms. I have before me a small series of workers taken at Davis, California, by Mr. Arnold Mallis. Some of the specimens have the shining promesonotum which supposedly marks *californicum* but others are heavily sculptured and fully as dull as *opacithorax*. It is possible, of course, to regard the latter individuals as aberrant but, if it can be shown that they are regularly produced in the population of *californicum*, it will, in my opinion, be very difficult to defend the validity of *opacithorax*. No definite settlement of this problem can be made until much more material of *californicum* has found its way into collections.

6. Eciton (Neivamyrmex) carolinense Emery

E. (*Acamatus*) *carolinense* Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 184 (1894) ♀ ; Emery, Zool. Jahrb. Syst., Vol. 8, p. 259 (1895) ♀ ; Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 56, p. 314, fig. 8c (1921) ♂.
E. carolinense Forel, Ann. Soc. Ent. Belg., Vol. 43, p. 443 (1899) ♀.
E. (*Neivamyrmex*) *carolinense* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 564, pl. 2, fig. 11, pl. 7, fig. 22 (1942) ♀ ♀ ♂.
Type loc: Belmont, Gaston County, North Carolina.
Types: M.C.Z., A.M.N.H.
Range: North Carolina and Tennessee south to the Gulf of Mexico.

7. Eciton (Neivamyrmex) commutatum Emery

E. (*Acamatus*) *commutatum* Emery, Mem. Accad. Sci. Bologna (5), Vol. 8, p. 522 (1900) ♀ ; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 413 (1908) ♀.
E. (*Neivamyrmex*) *commutatum* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 568, pl. 1, fig. 6 (1942) ♀.
Type loc: Grenada, B. W. I. Types: none in this country.
Range: in the United States, Kansas south to Texas and southwest to Arizona.

There has always been confusion in regard to *commutatum*. A number of the older records for this insect were attributed to *nitens*, a species endemic to Argentina and Uruguay. Although Emery was able to present structural criteria which permit the separation of *commutatum* from *nitens*, our present knowledge of the distribution of *commutatum* leaves much to be desired. According to Emery, *commutatum* ranges as far south as Bolivia and it is certainly present in the Antilles. But there seem to be no records from much of Mexico or northern South America. Dr. M. R. Smith records *commutatum* from Texas and Arizona only, but the insect occurs as far north as Kansas. I have before me a series of workers of *commutatum* taken by Hayes at Winfield, Kansas.

8. Eciton (Neivamyrmex) fuscipennis Wheeler

E. (*Acamatus*) *spoliator* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, pl. 26, fig. 12 (1908) ♂ (figure only, not description) (*nec E. spoliator* Forel).
E. (*Neivamyrmex*) *fuscipennis* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 578, pl. 4, fig. 15 (1942) ♂.
Type loc: Texas. Types: U.S.N.M.
Range: known from type material only.

The authorship of *fuscipennis* is an involved matter. The species was described by Cresson in a manuscript which was never published. Thereafter specimens bearing Cresson's manuscript name were examined by W. M. Wheeler. In 1908 Wheeler assigned these specimens to *spoliator* Forel. At this time Wheeler presented a translation of Forel's original description of *spoliator* and accompanied it with a figure which was, presumably, drawn from one of Cresson's specimens. No positive proof can be given that Cresson's specimens were the source of Wheeler's figure. Nevertheless, the inference is very strong, since Wheeler mentioned no other specimens. When M. R. Smith described *fuscipennis* in 1942, he failed to make it clear that Wheeler's authorship of that species rests entirely upon the figure which Wheeler attributed to *spoliator*. Since Dr. Smith feels sure that this figure is not *spoliator* but *fuscipennis*, I have followed him in treating Wheeler as the author of the latter species. It should be remembered, however, that Dr. Smith published the first description of *fuscipennis*.

9. Eciton (Neivamyrmex) harrisii (Haldeman)

Labidus harrisii Haldeman, Stansbury's Exp. Great Salt Lake, Lippincott, Grambo & Co., p. 367 (1852) ♂.

E. (*Acamatus*) *harrisii* Emery, Mem. Accad. Sci. Bologna (5), Vol. 8, p. 515, fig. 18 (1900) ♂; Wheeler & Long, Amer. Naturalist, Vol. 35, p. 166, fig. 2 d, e (1901) ♂; Wheeler, Bull. Amer. Must. Nat. Hist., Vol. 24, p. 413, pl. 26, fig. 10 (1908) ♂.

E. (*Neivamyrmex*) *harrisii* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 572, pl. 6, fig. 21 (1942) ♂.

Type loc: Ft. Gates, Texas. Types: none known to exist.

Range: Oklahoma and eastern Texas west to Arizona and south into Mexico.

Dr. Smith believes that *harrisii* may be the male of *wheeleri*.

10. Eciton (Neivamyrmex) leonardi Wheeler

E. (*Acamatus*) *leonardi* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 329 (1915) ♀.

E. (*Neivamyrmex*) *leonardi* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 570 (1942) ♀.

Type loc: Point Loma, San Diego, California. Types: M.C.Z.

Range: known from type material only.

11. Eciton (Neivamyrmex) melanocephalum Emery

E. (*Acamatus*) *melanocephalum* Emery, Zool. Jahrb. Syst., Vol. 8, p. 260 (1895) ♀.

E. (*Acamatus*) *melanocephalum* subsp. *xipe* Wheeler, Jour. N. Y. Ent. Soc., Vol. 22, p. 41 (1914) ♀.
E. (*Neivamyrmex*) *melanocephalum* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 549 (1942) ♀.
Type loc: Tepic, Mexico. Types: U.S.N.M.
Range: mountains of southern Arizona south into Mexico.

12. Eciton (Neivamyrmex) melsheimeri (Haldeman)

Labidus melsheimeri Haldeman, Stansbury's Exp. Great Salt Lake, Lippincott, Grambo & Co., p. 368, pl. 9, figs. 7, 8, 9 (1852) ♂.
E. (*Labidus*) *melshaemeri* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 442 (1886) ♂.
E. (*Acamatus*) *melsheimeri* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 418, pl. 26, fig. 9 (1908) ♂.
E. (*Neivamyrmex*) *melsheimeri* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 576, pl. 4, fig. 16 (1942) ♂.
Type loc: Ft. Gates, Texas. Types: none known to exist.
Range: Oklahoma and Texas south to Costa Rica and Guatemala.

13. Eciton (Neivamyrmex) minus (Cresson)

Labidus minor Cresson, Trans. Amer. Ent. Soc., Vol. 4, p. 195 (1872) ♂.
E. (*Labidus*) *minor* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 441 (1886) ♂.
E. (*Acamatus*) *minus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 418, pl. 26, fig. 6 (1908) ♂.
E. (*Neivamyrmex*) *minus* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 574, pl. 4, fig. 17 (1942) ♂.
Type loc: Bosque County, Texas. Types: A.N.S.P.; U.S.N.M.
Range: Oklahoma and Kansas southwestward through Texas, New Mexico and Arizona. The insect also occurs in Mexico.

14. Eciton (Neivamyrmex) mojave M. R. Smith

E. (*Neivamyrmex*) *mojave* M. R. Smith, Lloydia, Vol. 6, p. 196 (1943) ♂.
Type loc: Mojave Desert, California. Types: U.S.N.M.
Range: known only from type material.

15. Eciton (Neivamyrmex) nigrescens (Cresson)

Labidus nigrescens Cresson, Trans. Amer. Ent. Soc., Vol. 4, p. 194 (1872) ♂.
E. (*Acamatus*) *nigrescens* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 417, pl. 26, figs. 7, 9 (1908) ♂; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 40, p. 157 (1938) ♀ ♂.

E. (*Neivamyrmex*) *nigrescens*, M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 550, pl. 1, fig. 4, pl. 2, fig. 10, pl. 7, fig. 23 (1942) ♀ ♂ ♀; M. R. Smith, Ibid., Vol. 37, No. 3, p. 526, pl. 1, fig. 2 (1947) ♀.

E. (*Acamatus*) *schmitti* Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 183 (1894) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 258 (1895) ♀; Wheeler & Long, Amer. Naturalist, Vol. 35, p. 161, fig. 1 (1901) ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 410, pl. 26, fig. 13 (1908) ♂; Emery in Wytsman, Genera Insectorum, Fasc. 102, pl. 1, figs. 4, b, c, d (1910) ♀ ♀ ♂; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 20, p. 401 (1927).

Eciton sumichrasti Mayr (part) Verh. Zool-bot. Ges. Wien, Vol. 36, p. 440 (1886); Wheeler, Amer. Naturalist, Vol. 34, p. 464, figs. 1, 2, 3 (1900) ♀ ♀ (not Norton).

Type loc: male—Bosque County, Texas. Types: male—A.N.S.P.; worker—Doniphan, Missouri; worker—M.C.Z.; female—unknown.

Range: coast to coast in the southern United States. In the east the northern limit of the range appears to lie close to Lat. 38° but in the middle west it extends a little north of Lat. 40°. In the far west it drops to about Lat. 35°. The insect appears to be rare in California although it is moderately abundant in parts of southern Arizona.

In many respects it is unfortunate that it was necessary to synonymize *schmitti* with *nigrescens*, for the former name has been so long used for the worker of this insect that a certain amount of confusion is to be expected. The evidence which Dr. Smith presented in 1938, however, clearly shows that Cresson's name must take priority. The range of *nigrescens* is by far the most extensive of any species of Neivamyrmex which occurs in the United States. In the middle west it ranges as far north as Nebraska and Iowa. Oddly enough there appear to be no Mexican records although the insect must certainly occur there.

16. Eciton (Neivamyrmex) opacithorax Emery

E. californicum subsp. *opacithorax* Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 184 (1894) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 259 (1895) ♀.

E. (*Acamatus*) *opacithorax* Emery, Mem. Accad. Sci. Bologna, Vol. 8, p. 524 (1900); Wheeler & Long, Amer. Naturalist, Vol. 35, p. 163, figs. 2c, 3 (1901) ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 411, pl. 26, fig. 4 (1908) ♂.

E. (*Neivamyrmex*) *opacithorax* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 555, pl. 2, fig. 9, pl. 6, fig. 20 (1942) ♀ ♀ ♂.

E. (*Acamatus*) *carolinense* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 56, p. 314, fig. 8 a, b (1921) ♀ (not Emery).

Type loc: worker—Doniphan, Missouri.
female—Belmont, North Carolina;
male—Austin, Texas;
Types: worker—U.S.N.M., M.C.Z.;
female—M.C.Z.?;
male—M.C.Z.
Range: North Carolina and Tennessee south to the Gulf of Mexico and westward to Texas and New Mexico. The worker types appear to have been taken at the northern limit of the range. Doniphan is a few miles north of the Missouri-Arkansas border.

17. Eciton (Neivamyrmex) oslari Wheeler

E. (*Acamatus*) *oslari* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 415, pl. 26, fig. 8 (1908) ♂.
E. (*Neivamyrmex*) *oslari* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 579, pl. 5, fig. 18 (1942) ♂.
Type loc: Nogales, Arizona. Type: A.M.N.H.
Range: known only from southern Arizona. Most of the records come from mountainous areas.

18. Eciton (Neivamyrmex) pauxillum Wheeler

E. (*Acamatus*) *pauxillum* Wheeler, Psyche, Vol. 10, p. 93, fig. 1 (1903) ♀.
E. (*Neivamyrmex*) *pauxillum* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 569, pl. 1, fig. 8 (1942) ♀.
Type loc: Austin, Texas. Types: A.M.N.H.; M.C.Z.
Range: central and western Texas.

19. Eciton (Neivamyrmex) pilosum F. Smith

E. pilosa F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 151 (1858) ♀.
E. pilosum Mayr, Novara Reise Formicid., p. 77 (1865); Mayr, Wien Ent. Zeit., Vol. 5, p. 120 (1886).
E. (*Acamatus*) *pilosum* Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 183 (1894) ♀; Emery, Mem. Accad. Sci. Bologna (5), Vol. 8, p. 524 (1900) ♀.
E. (*Neivamyrmex*) *pilosum* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 544, pl. 1, fig. 7, pl. 3, fig. 13 (1942) ♀ ♂.
Labidus mexicanum F. Smith, Cat. Hym. Brit. Mus., Vol. 7, p. 7 (1859) ♂.
E. (*Acamatus*) *mexicanum* Emery, Mem. Accad. Sci. Bologna (5), Vol. 8, p. 515, fig. 19 (1900) ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 414, pl. 26, fig. 11 (1908) ♂; Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 56, No. 8, p. 313, fig. 7 (1921) ♂; M. R. Smith, Jour. N. Y. Ent. Soc., Vol. 39, p. 295 (1931) ♂.
Eciton clavicornis Norton, Trans. Amer. Ent. Soc., Vol. 2, p. 46 (1868) ♀.

Eciton subsulcatum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 440 (1886) ♂.
Type loc: worker—Villa Nova, Brazil. Types: British Museum.
male—Orizaba, Mexico.
Range: Mississippi and Arkansas westward through Oklahoma and Texas and southward to Brazil.

20. Eciton (Neivamyrmex) pilosum mandibulare M. R. Smith

E. (*Neivamyrmex*) *pilosum* subsp. *mandibulare* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 548, pl. 3, fig. 14 (1942) ♂.
Type loc: Thirty miles east of Quijotoa, Pima Co., Arizona.
Types: U.S.N.M., Coll. Cornell Univ.
Range: known from southern Arizona only.

Dr. Smith has shown that the specimens of *pilosum* (*mexicanum*) which Wheeler recorded from Nogales belong to *mandibulare* and he is of the opinion that specimens from Las Cruces, New Mexico, also belong to this subspecies. The range of the typical *pilosum* would, therefore, appear to terminate in western Texas and that of the subspecies *mandibulare* would begin in that area and run westward through southern New Mexico and Arizona.

21. Eciton (Neivamyrmex) wheeleri Emery

E. (*Acamatus*) *wheeleri* Emery, Bull. Soc. Ent. Ital., Vol. 33, p. 55 (1901); Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 412 (1908) ♀.
E. (*Neivamyrmex*) *wheeleri* M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 561, pl. 1, fig. 5 (1942) ♀ ♀.
E. (*Acamatus*) *wheeleri* subsp. *dubia* Creighton, Psyche, Vol. 39, p. 73, pl. 3, figs. 1, 2, 3 (1932) ♀ ♀.
Type loc: worker—Hays County, Texas.
female—Ft. Worth, Texas;
Types: worker—M.C.Z.;
female—Coll. W. S. Creighton.
Range: central Texas south into Mexico.

I agree with Dr. Smith that the subspecies which I described as *dubia* is a synonym of *wheeleri*. At the time when *dubia* was described I had no material of *wheeleri* for comparison and the characters employed for the recognition of *dubia* were those reported by Wheeler, to whom specimens had been sent for comparison with the types of *wheeleri*. I have since been able to examine the types of *wheeleri* and have seen considerable additional material belonging to this species. Dr. Smith is quite correct in stating that the characters which supposedly mark *dubia* are inconstant and without taxonomic significance.

Subfamily PSEUDOMYRMINAE

Genus PSEUDOMYRMA Latreille

(Plate 13, figures 1–4)

There has been such a notable lack of uniformity regarding the authorship of the genus Pseudomyrma that some attempt must be made to clarify the existing confusion. At different times Pseudomyrma has been attributed to Latreille, Lund, Guérin and Frederick Smith. It is difficult to understand why this situation has arisen, for the point involved is not complicated. In 1804 Fabricius described three new species of Neotropical ants (*gracilis*, *tenuis* and *filiformis*) and these he assigned to the old, heterogeneric, Linnaean genus Formica. Latreille later recognized these species as representatives of a separate genus, which he proposed to call Pseudomyrma. His suggestion was not published under his own name but carried in a paper by Lund, that appeared in 1831. There seems to be no question that this represents the earliest date for the use of the generic name Pseudomyrma. Since Guérin did not employ the name until 1845 and F. Smith even later (1855), there is no possible justification for considering either of these men as the author of the genus Pseudomyrma. The question involved turns upon whether Lund intended to attribute the authorship of Pseudomyrma to Latreille. Carlo Emery, the only myrmecologist who seems to have given much thought to this matter, is of the opinion that this was the case, and that Latreille must be considered the author of Pseudomyrma. I see nothing to be gained by contesting this point and trust that other students of ants may see the matter in the same light.

The subfamily Pseudomyrminae is a comparatively small group consisting of four genera. Three of these are confined to the Old World tropics. The fourth genus, Pseudomyrma, is found only in the New World and the great majority of the species which compose it are limited to the tropics. There are, however, a few species which range into subtropical areas. Of these, only four have a distribution which brings them within the borders of the United States. Because of this our species can be readily handled, despite the fact that the taxonomy of Pseudomyrma is hopelessly involved. Throughout the genus there is an unusually close structural similarity between species. Moreover, many species are highly variable in minor features and these variations have often been named. It is often impossible to secure a clear cut distinction between species and it is not surprising that most myrmecologists have made no attempt at monographic studies on Pseudomyrma. The one effort in this direction is the survey published by Enzmann in 1944. Although Enzmann's studies were based in large

part on the Wheeler Collection in the Museum of Comparative Zoölogy, he failed to avail himself of this excellent opportunity for sound revisionary work. Instead his incredible disregard for the most basic rules of nomenclature has produced a paper that is little more than a taxonomic curiosity. No reliance can be placed in Enzmann's descriptions, keys or figures and about the only result of his study has been to make confusion much worse confounded.

The habits of Pseudomyrma appear to be remarkably uniform. They are usually spoken of as arboreal insects but it is more accurate to say that they prefer to nest in preformed plant cavities. If the cavity is suitable the size of the plant seems to be a matter of little concern, hence they will nest with equal freedom in the hollow twigs of trees, the stalks of herbaceous plants and even in the stems of some of the larger grasses. Many of the species are, nevertheless, restricted to one species of plant or even to one part of a plant. Among these are the celebrated Acacia ants, which nest in the swollen bases of the large spines that give the bull-horn Acacia its popular name. Most species of Pseudomyrma are active and agile insects. Some of them are surprisingly aggressive, particularly in resisting any disturbance to the nest. The feeding habits of the adult Pseudomyrma show little evidence of specialization. So far as is known, all the species are omnivorous, feeding upon honeydew, the softer tissues of plants and the tissues of other insects. Their method of feeding the larvae, on the other hand, is a peculiar and specialized process found in all the pseudomyrmine genera but not known elsewhere in the Formicidae. We owe our knowledge of the feeding habits of the larval stages of Pseudomyrma almost entirely to the investigations of Wheeler and Bailey who, in 1920, published an exhaustive account of this matter. The brief summary presented in the following paragraph is only a small part of the information contained in their admirable study.

The head of the pseudomyrmine larva is quadrate in shape and larger than that of other ant larvae. Beneath it lies a cluster of papillae (the exudatoria) which arise from the thoracic and the first abdominal segments. Between these papillae the first abdominal segment is expanded into a sort of a shelf or pocket (the trophothylax) that underlies the mouth of the larva. Food is placed in this pocket by the workers. This food is of a very unusual sort. It consists of bits of tissue which have collected in the infrabuccal pocket of the worker and from which most of the juices have been sucked by the worker before it is deposited on the trophothylax of the larva. The deposited pellet is, therefore, rather firm and dry, and not available for immediate ingestion by the larva. But the larva proceeds to rectify this matter by grinding the pellet between two opposable plates (the

trophorinium) which are covered with very fine striae. After the pellet has been finely comminuted the fragments are swallowed. It is presumed that this process of comminution not only makes it possible for the larva to swallow the pellet but also releases particles of food which had escaped digestion in the infrabuccal pocket of the worker. It may be added that in all other ants except the Pseudomyrminae the contents of the infrabuccal pocket are regularly discarded.

Key to the species of Pseudomyrma

1. Erect hairs numerous on all parts of the body and the appendages; length 8 mm. or more; head, thorax and petiole maculate, black and reddish yellow, gaster black.....*gracilis* subsp. *mexicana*
   Erect hairs sparse or absent on body and appendages; length 5 mm. or less; concolorous or nearly so.....2
2. Head, thorax and gaster covered with fine, dense, appressed, greyish pubescence; upper surface of the head and thorax strongly shagreened and dull.....*elongata*
   The appressed pubescence very sparse or lacking altogether over much of the body; upper surface of the head and thorax feebly shagreened or with small scattered punctures, the surface moderately to strongly shining....3
3. Mesoepinotal suture strongly impressed; the sides of the postpetiole which slope inward to the anterior peduncle slightly concave when viewed from above; head and thorax yellowish brown, the entire gaster blackish brown *brunnea*
   Mesoepinotal suture feebly impressed; the sides of the postpetiole which slope inward to the anterior peduncle straight or slightly convex when seen from above; color clear yellow, the gaster often with two brownish spots at the base.....*pallida*

1. Pseudomyrma brunnea F. Smith

Ps. brunnea F. Smith, Trans. Ent. Soc. Lond., p. 63 (1877) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 269 (1895) ♀ ♀; Forel, Biol. Centr. Amer. Hym., Vol. 3, p. 97 (1899) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 420 (1908) ♀ ♀.

Type loc: Mexico. Types: none in this country.

Range: South Carolina south into Florida and westward through the southern portion of the Gulf Coastal Plain into Mexico.

2. Pseudomyrma elongata Mayr

Ps. elongata Mayr, Sitz. ber. Akad. Wien, Vol. 61, p. 413 (1870) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 85 (1905) ♀ ♀ ♂.

Type loc: New Grenada, B. W. I. Types: none in this country.

Range: southern Florida. It is interesting to note that the typical *elongata* ranges southward through the Bahamas and the Lesser Antilles to Colombia. It has produced distinct geographical races in Cuba, Haiti and Central America but it is not at present known from Mexico although it may occur in the southern portion of that country. These facts seem to indicate rather clearly that *elongata* entered the United States through the Antilles and not by way of Mexico.

3. Pseudomyrma gracilis mexicana Roger

Ps. mexicana Roger, Berl. Ent. Zeitschr., Vol. 7, p. 178 (1863) ♀.
Ps. gracilis var. *mexicana* Mayr, Sitz. Verh. Akad. Wis. Wien, Vol. 61, p. 409 (1870); Emery, Bull. Soc. Ent. Ital., Vol. 22, p. 60, pl. 5, fig. 16 (1890) ♀.
Ps. gracilis subsp. *mexicana* Forel, Mitt. Naturh. Mus. Hamburg, Vol. 24, p. 7 (1907); Enzmann, Psyche, Vol. 51, Nos. 3, 4, p. 65, pl. IV, figs. 29, 33 (1944) ♀.
Type loc: Mexico. Types: none in this country.
Range: the Brownsville region of Texas and south into Mexico.

4. Pseudomyrma pallida F. Smith

Ps. pallida F. Smith, Trans. Ent. Soc. Lond. (2), Vol. 3, p. 160 (1855) ♀; Forel, Biol. Centr. Amer. Hymenop. III, p. 92 (1899) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 419 (1908) ♀.
Ps. flavidula var. *pallida*, Enzmann, Psyche, Vol. 51, Nos. 3, 4, p. 66 (1944) ♀.
Ps. flavidula M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 544, pl. 5, fig. 17 (1947) ♀.
Type loc: east Florida. Types: none in this country.
Range: South Carolina south to Florida and westward through the southern portion of the Gulf Coastal Plain into Mexico. There are also scattered records from southern Arizona and southern California. The insect occurs widely throughout the Antilles, Mexico, Central America and as far south as the Amazon Basin in South America.

For many years myrmecologists have displayed a surprising agility in skirting the problem of what to do with *pallida* and *flavidula*. It seems time that someone grasped the nettle and attempted a clarification of the problem, particularly as a recent blunder by Enzmann has added new confusion. In his study on Pseudomyrma, Enzmann treated *pallida* as a variety of *flavidula*. Since *pallida* was described in 1855 and *flavidula* in 1858 the first name clearly has priority and Enzmann's treatment is a violation of the rules of nomenclature. But this is by no means the worst that can be said of Enzmann's error. It clearly calls for rectification and the correction which is almost certain to be proposed is the transposition of the two names with

flavidula made a variety of *pallida*. Thus Enzmann has set the stage for the synonymization of *flavidula*, a step which has been sedulously avoided by myrmecologists for almost a century. If *flavidula* is to be regarded as cospecific with *pallida* it should be for a better reason than the need for correcting Enzmann's mistake. The relationship of *flavidula* to *pallida* is a highly complicated matter and there is reason to believe that at present it is impossible to clear away all the difficulties which are involved. But it is certain that much can be done toward bettering our knowledge of the problem insofar as it applies to the specimens which occur in the United States. As will be shown in a subsequent paragraph, these specimens are of special significance. It is best to begin this discussion with the event which is responsible for the problem—the description of *flavidula* by Frederick Smith in 1858.

Smith's *flavidula* was saved from the limbo which holds many of his unrecognizable species by the fact that its original description carried a reference to a very minor detail of color. The gaster was marked at the base by two brownish spots, instead of being entirely yellow as in the case of *pallida*. Myrmecologists are not, as a rule, inclined to place much trust in color as a character for specific determination. Yet despite two subsequent descriptions of the worker of *flavidula* and other efforts which have been made to give it morphological distinction, it is a fact that gastric coloration is still the principal criterion for the recognition of *flavidula*. Since Smith's description is otherwise worthless, there is a sound reason for this unusual situation. If one is not prepared to accept *flavidula* as a version of *pallida* with a spotted gaster then there is no way of telling what it is.

In their preoccupation with these gastric markings, most myrmecologists appear to have neglected certain geographical data which were also included in Smith's descriptions. The type of *pallida* came from eastern Florida, that of *flavidula* from Santarem, Brazil. This circumstance enables us to be certain of what *pallida* is without reference to a type and despite Smith's inadequate description. For there are only three species of Pseudomyrma in Florida and only one of them is yellow. Moreover the population of this yellow Pseudomyrma shows an astonishing uniformity of structure. Indeed the only variable feature about it is the gastric coloration which may be either clear or spotted. It is certain, therefore, that the type of *pallida* must have come from this population. No such certitude is possible in the case of *flavidula*. There are a number of yellow species of Pseudomyrma in northern Brazil and several of them show gastric markings. Smith's description might apply to any one of these species. It is easy to appreciate why little mention has been made of this latter fact. No

one has wished to admit that *flavidula* is an unrecognizable species. But to repeat what was said at the end of the last paragraph, if one is not prepared to accept *flavidula* as a version of *pallida* with a spotted gaster then there is no way of telling what it is.

I wish to stress the last point strongly, for it is clear that this is exactly what most myrmecologists have done. They have given the name *flavidula* to specimens of *pallida* which have gasters with brown spots. That such specimens are not specifically distinct is true, indeed they do not seem to deserve even varietal status. But it is one thing to show that these specimens are specifically identical with *pallida* and quite another to prove them the same as the insect to which Smith gave the name *flavidula*. The remedy to the *pallida-flavidula* problem involves not the synonymization of *flavidula*, but the realization of the fact that the gaster of *pallida* is not always a clear yellow. This view will probably be difficult to establish since it runs counter to customary practice. Despite the fact that there are always "off colored" individuals in a nest series of any length, the significance of these is usually disregarded. If any specimens with spots are present the colony is plainly "*flavidula*," hence most of the records of *pallida* are based upon strays and fragments of colonies. It follows that there will always be a great many more records for "*flavidula*" than for *pallida* and this is clearly shown in Wheeler's 1932 publication on Florida ants. The records for "*flavidula*" are three times as numerous as those for *pallida* and Wheeler explained this on the assumption that the latter insect was "less abundant". What he actually had was a demonstration of the fact that it is virtually impossible to find a nest series of *pallida* in which there are not some individuals with spotted gasters.

The broader aspects of the *pallida-flavidula* problem lie outside the scope of this book. For its final solution will involve the reëxamination of Smith's type of *flavidula*, assuming that this still exists, and a much better knowledge of the South American species of Pseudomyrma than we have at present. But this is a difficulty which need trouble only those who have to deal with the ants of that region. As far as the student of North American ants is concerned the *pallida-flavidula* problem ceases to exist the moment that he recognizes the inherently variable color pattern in the gaster of *pallida*.

Subfamily MYRMICINAE

It is difficult to speak in general terms about the Subfamily Myrmicinae, for no other group of ants shows so much variation in morphology and habits. Some of the genera have retained a rather primitive

structure (Myrmica, Manica); others are among our most highly evolved ants (Strumigenys, Cryptocerus, etc.). The majority of the genera fall between these extremes in the amount of structural differentiation which they show.

These ants exhibit so many different sorts of habits that it is possible to give only the more general patterns here. An entire group of genera in the tribe Attini are fungus growers and their activities in cultivating their fungus gardens are among the most remarkable to be found in ants. Many genera are highly graminicolous (Pogonomyrmex, Veromessor, Pheidole etc.) and those species in which this trait is best developed are often found in arid or desert areas. There are at least two genera whose representatives are largely arboreal (Xenomyrmex, Cryptocerus). There is one genus of slavemakers (Harpagoxenus) and three of workerless parasites (Sympheidole, Epoecus and Anergates). The genus Leptothorax contains a number of species which are inquilines in the nests of other ants and Solenopsis has a high proportion of species which behave as thief ants. It is interesting to note that one of the few genera which appears to be entirely carnivorous is the highly developed Strumigenys. These remarkable ants, so far as is known, live largely on Collembola, which they capture by a combination of stealth and the use of a peculiar mandibular mechanism. Hence it is probable that this carnivorous diet represents a secondary specialization rather than a retention of the primitive feeding habits of the ponerines.

Key to the Genera of the Subfamily Myrmicinae

1. Workers absent 2
   Workers present 4
2. Gaster of the female with a broad impression at the base of the gaster or with a deep longitudinal furrow extending its full length 3
   Gaster of the female without basal impression or longitudinal furrow .... *Sympheidole*
3. Gaster of the female with a broad flat impression on the dorsum of the first segment ..... *Epoecus*
   Gaster of the female with a deep longitudinal furrow extending its full length ..... *Anergates*
4. Antennae with six segments ..... *Strumigenys*
   Antennae with more than six segments 5
5. Body much flattened, the frontal carinae very large and expanded laterally so that they form an overhanging rim at the edge of the head, beneath which is a deep scrobe for the reception of the antennae; head of the major appearing like a shallow, oval saucer when viewed from above ..... *Cryptocerus*

Body not flattened, antennal carinae not as described above, the head of the major, when that caste is present, not saucer-like when viewed from above.....6

6. Postpetiole attached to the dorsal surface of the first gastric segment, the gaster flattened dorsally but much more convex ventrally, acutely pointed behind.....*Crematogaster*
Postpetiole attached to the anterior end of the first gastric segment, the gaster about equally convex above and below and not notably pointed behind.....7

7. Antennae with ten segments, the last two forming a very distinct club.. *Solenopsis*
Antennae with more than ten segments, the club, if present, only rarely of two segments.....8

8. Antennae with eleven segments.....9
Antennae with twelve segments.....19

9. Dorsum of the pronotum, mesonotum and epinotum with spines, teeth, rounded bosses or prominent ridges present; antennal fossa always bounded by a delicate carina which runs diagonally inward from the insertion of the mandible past the inner border of the eye.....10
Dorsum of the pronotum and mesonotum without spines, projecting bosses or ridges; spines and teeth, when present, confined to the epinotum; antennal fossa only rarely bordered by a diagonal carina and when this is present the size of the worker does not exceed 2 mm.....14

10. Frontal carinae projecting forward above the clypeus, largely or entirely concealing its lateral portions when the head is viewed from above; thoracic spines, when present, short and dentiform.....11
Frontal carinae shorter, not projecting above the clypeus or at most projecting over its posterior half, the full width of the clypeus visible from above; thoracic spines long and prominent.....12

11. Pro-, meso- and epinotum each with a pair of short teeth or denticles; body hairs at least in part erect, those of the gaster arising from small but distinct tubercles.....*Mycetosoritis*
Pro-, meso- and epinotum with bosses or carinae but not armed with denticles; body hairs scale-like, appressed; gaster not tuberculate..... *Cyphomyrmex*

12. Thoracic dorsum armed with three pairs of spines; large highly polymorphic species, the length of the worker varying from 2–12 mm.....*Atta*
Thoracic dorsum armed with more than three pairs of spines; less polymorphic or monomorphic species of smaller size, length 6 mm. or less..13

13. Entire insect, including the antennal scapes and legs, covered with numerous small tubercles; frontal carinae extending almost to the posterior corners of the head; occipital emargination shallow.....*Trachymyrmex*
Tubercles confined largely to the gaster, postpetiole and the tops of the occipital lobes; frontal carinae indistinct behind and not extending to the occipital corners; occiput deeply emarginate in the largest workers..... *Acromyrmex*

14. Epinotum unarmed; petiole subcylindrical, without a node above..... *Xenomyrmex*

Epinotum armed with spines or short teeth; node of the petiole well developed 15

15. Antennal club very distinct and consisting of two segments which are notably broader and longer than the seven small segments that precede them ..... *Erebomyrma*
Antennal club, if present, consisting of more than two segments, usually not separated abruptly from the remainder of the funiculus 16

16. Frontal carinae extending rearward at least two-thirds of the distance to the posterior corners of the head and each bordering a shallow scrobe for the reception of the antennal scape, the latter often much flattened ... 17
Frontal carinae short, no antennal scrobes present, the antennal scape not flattened ..... *Leptothorax*

17. Postpetiole strongly transverse; humeri rounded; length 3.2 mm. or more 18
Postpetiole about as broad as long; humeri markedly angular; length 1.5–2 mm. ..... *Wasmannia*

18. Antennal scrobe narrow, usually obliterated by the heavy sculpture except immediately under the overhanging edge of the frontal carina; head, thorax and petiolar nodes strongly reticulo-rugose ..... *Xiphomyrmex*
Antennal scrobe broad, its width extending almost to the inner border of the eye; sculpture everywhere delicate ..... *Harpagoxenus*

19. Middle and hind tibial spurs very finely pectinate, the teeth distinct and regular but usually too small to show unless a magnification of 100 diameters or more is used 20
Middle and hind tibial spurs simple or absent, very rarely with a few barbules but never pectinate 22

20. Thoracic dorsum with the sutures obsolescent or absent; thorax not impressed between the mesonotum and epinotum; psammophore usually present ..... *Pogonomyrmex*
At least the mesoepinotal suture present and distinct on the thoracic dorsum; thorax impressed at the mesoepinotal suture; psammophore absent 21

21. Epinotum armed with spines or teeth; promesonotal suture absent on the thoracic dorsum; mesoepinotal suture moderately impressed .... *Myrmica*
Epinotum not armed with spines or teeth, usually evenly rounded but rarely with blunt protuberances present; promesonotal suture visible on the thoracic dorsum but often faint; mesoepinotal suture strongly impressed ..... *Manica*

22. Petiole subcylindrical, without a distinct node above ..... *Myrmecina*
Petiole with a distinct node, the anterior peduncle distinct, even when short 23

23. The lateral portions of the clypeus raised behind into a narrow ridge or carina which forms an abrupt, semicircular boundary at the front of the antennal fossa 24
The lateral portions of the clypeus not raised in a semicircular ridge behind; the antennal fossae opening onto the clypeus without a boundary or occasionally the entire lateral portion of the clypeus tilted to the rear so that it forms a sloping boundary to the antennal fossa 25

24. Many of the numerous, erect body hairs branched or trifid. . *Triglyphothrix*
Erect body hairs simple ..... *Tetramorium*
25. Epinotum unarmed, the basal face at the same level as the dorsum of the mesonotum ..... *Monomorium*
Epinotum usually armed with spines or teeth but, if unarmed, the basal face is distinctly below the level of the dorsum of the mesonotum 26
26. Worker caste dimorphic (rarely polymorphic) with the head of the major disproportionally large ..... *Pheidole*[1]
Worker caste monomorphic, or if polymorphic, the head of the major is not disproportionally large 27
27. Thoracic dorsum with the mesoepinotal suture absent or very faintly indicated 28
Thoracic dorsum with the mesoepinotal suture well-marked 30
28. Large species, 10–12 mm. in length with the antennal scapes projecting well beyond the occipital border ..... *Novomessor*
Small species not over 4 mm. in length and often less; the antennae usually not surpassing the occipital border and never projecting much beyond it 29
29. Thoracic dorsum flat or feebly convex in profile; anterior peduncle of the petiole short, thick and not sharply set off from the node; epinotal spines short or at most of moderate length ..... *Leptothorax*
Thoracic dorsum distinctly convex in profile; anterior peduncle of the petiole long, usually thin and always sharply set off from the node; epinotal spines long ..... *Macromischa*
30. Epinotum depressed well below the level of the pronotum, in profile the mesonotum forming a sloping declivity between them; antennal club indistinct, of 4–5 segments 31
Thorax seen in profile with the epinotum as high as the promesonotum, the thoracic dorsum usually forming an unbroken plane, more rarely with the epinotum separated from the mesonotum by a deep impression; antennal club of three segments ..... *Leptothorax*[2]
31. Postpetiole only slightly constricted behind, the node low and not sharply set off from the thick posterior peduncle; head quadrate, not notably narrower behind the eyes than in front of them; psammophore often present ..... *Veromessor*
Postpetiole more strongly constricted behind, the node distinct and sharply set off from the posterior peduncle; head longer than broad and often much narrower behind the eyes than in front of them; psammophore never present ..... *Aphaenogaster*

[1] Since the discovery of the minor worker of Epipheidole by Dr. M. R. Smith there is no satisfactory way in which this genus can be separated from Pheidole. It is not a workerless parasite, as was formerly supposed, and the breakdown of this characteristic has destroyed the main distinction on which the recognition of Epipheidole was based. Means for separating *Epipheidole inquilina* from its host, *Ph. pilifera coloradensis* have been given elsewhere.

[2] There seems to be no satisfactory structural distinction by which the worker of Symmyrmica can be separated from Leptothorax. The presence of an impressed mesoepinotal suture will not separate this insect from species in the subgenus Dichothorax. Since the main generic distinction of Symmyrmica appears to be its ergatoid male, this feature must be used to distinguish it from Leptothorax.

Genus MYRMICA Latreille

(Plate 14, figures 1–4)

At the present time the taxonomy of the genus Myrmica is in a condition of unparalleled complexity. Repeated revisions of the group have intensified rather than diminished this situation. Since certain proposals followed in this volume differ from the treatment previously accorded to some of our representatives, it is necessary to present an account of earlier taxonomic developments within the genus Myrmica.

For many years after Latreille established the genus Myrmica it contained only two species, the Linnaean *rubra* and Latreille's species *rubida* (now in the genus Manica). In 1846 Nylander added five new species, *laevinodis, lobicornis, ruginodis, scabrinodis* and *sulcinodis.* The genus retained essentially this character until 1874, at which time Forel published his *Fourmis de la Suisse.* In this work Forel treated all of Nylander's species as races of *rubra.* This association was primarily based on the structural similarities of the worker caste. While Forel's view was too extreme it served to emphasize the lack of good delimiting characters in the case of the worker. Before other students could restore the various forms to specific status they were compelled to present better reasons than the fine distinctions which marked the worker. These reasons, when they appeared, involved the structure of the male. After a few years *lobicornis* was restored to specific rank because the male possesses an antennal scape which is bent at the base. A difference in the number of joints which form the funicular club permitted the restoration of *scabrinodis* to specific status.

The utility of the male in specific delimitation soon led to its use as a means for subspecific recognition. As will be shown, the results of this practice have not always been satisfactory. The particular instance which concerns the student of North American ants is the *sabuleti-schenki* tangle. This forms one of the rare lapses in Emery's excellent monograph of our ant fauna. The form *sabuleti* had been described by Meinert as a separate species in 1860. Thereafter it had been generally neglected until Emery suddenly referred to it in the 1895 portion of his treatise on North American ants. Meinert's types of *sabuleti* had been taken in Norre-Vosberg, Denmark, a fact which did not deter Emery from stating that *sabuleti* is the commonest form of Myrmica in America. Emery seemed much surer of these American specimens than of the "almost identical" European form which he assigned to Meinert's species. Emery frankly admitted that

there was no sure way in which the workers and females of *sabuleti* could be separated from the typical *scabrinodis*. The male of *sabuleti*, however, could be distinguished by the longer scape in the American specimens. The males of the European representatives of *sabuleti* were "rather variable" as to scape length. If one takes the trouble to unravel this remarkable statement, it is apparent that Emery could recognize *sabuleti* only by using the American males, and that the intergrading European examples were for all practical purposes indistinguishable from the typical *scabrinodis*. Having defined the variety *sabuleti*, Emery proceeded to set up another, *schenki*. The antennal scape of the male of *schenki* was very short and its worker possessed a lobed scape which had led to confusion of the form with *lobicornis*. Here, as in the case of *sabuleti*, the definitive characters were to be found in the male and, as in *sabuleti*, the insect occurred both in Europe and the United States. No type citation was made for *schenki* because of the earlier descriptions which had confused this insect with *lobicornis*. Emery's interpretation has had a wide acceptance among students of myrmecology. Despite this fact, it cannot be regarded as satisfactory. The first doubts in this particular were raised by Forel in 1914. In that year he pointed out that the American representatives which had been assigned to *schenki* were not the same as those of Europe. He therefore separated the American form as the variety *emeryana*. Very little attention was paid to Forel's observation although it held the key to the situation. Most publications dealing with our species of Myrmica continued to follow Emery's system, although Emery himself threw it over when he published the Myrmicine section of the *Genera Insectorum* in 1921. In that work the forms *sabuleti* and *schenki* are recorded as coming from Europe only. Forel's *emeryana* had taken care of the New World form misidentified as *schenki*. The American specimens which Emery had considered as representatives of *sabuleti* were allowed to drop out of sight. This insect, which has repeatedly appeared in the literature since 1895 under the name *sabuleti*, was not named until Weber described it as the subspecies *americana* in 1939.

The remainder of the history of *sabuleti* and *schenki* involves a series of revisionary studies made on the European forms of Myrmica during the period from 1918 to 1931. These studies were not concerned with the North American species but they affect them none the less. In 1918 Bondroit published a monograph on the ants of France and Belgium. In this work he presented a drastic revision of Myrmica in which he added three new species and accorded specific rank to many forms previously considered subspecies or varieties. Both *sabuleti* and *schenki* were among the forms raised to specific rank.

Bondroit's work was dealt with in a most uncompromising fashion by Emery in 1921. His three species were reduced to varietal rank and the other changes which he proposed were nullified. Those who regard Emery as a taxonomic reactionary will do well to consider that extensive subsequent investigation has confirmed Emery's opinion in regard to the species which Bondroit described. It is to be regretted that less unanimity of opinion has attended his treatment of *sabuleti* and *schenki*. In 1926 Finzi monographed the European species of Myrmica and accorded *schenki* specific status. He refused, however, to make a similar concession in the case of *sabuleti*. Two years later Stärcke, who had examined Mienert's types of *sabuleti*, championed specific status for that form. The specificity of both *sabuleti* and *schenki* was conceded by Santschi when he reviewed the European species of Myrmica in 1931. In this paper Santschi was at some pains to evaluate the various indices which had been proposed as solutions to the Myrmica problem. He discussed the "frontal index" favored by Stärcke (the ratio of the greatest width of the head through the eyes to the maximum divergence of the frontal lobes), his own "epinotal index" (the relationship between the infra-spinal incision and the lobe at the base of the epinotum) and the old stand-by, the length of the antennal scape of the male. Santschi's conclusions are as discouraging as they are shrewd. There is scarcely a page on which he does not point out the variability and intergradation of diagnostic characters. Nearly all the varieties are "relative" and can be determined only by statistical studies on long series of specimens. Although Santschi was of the opinion that the best criterion of specificity is the character of the antennal scape of the male, his studies showed that even this characteristic is not always constant.

In the opinion of the writer Santschi's observations on Myrmica are the only ones which hold much hope for the betterment of the taxonomy of this desperately difficult group. If the classification of Myrmica is to be placed on a reasonable basis, we must place less stress on varietal differences and more on adequate specific delimitation. In other words, we must give up the idea, to which Forel and Emery so faithfully adhered, that *scabrinodis* consists of a huge complex of forms none of which deserve specific status. We shall have to accept the fact that when this complex is broken down the species which result are less distinct than could be wished and that it is usually necessary to augment the lack of good definitive characters in the worker caste with characteristics derived from the male. Nevertheless, there appears to be no other possible course, for it can be shown on distributional grounds that whatever the members of Emery's *scabrinodis* complex may be, they are certainly not subspecies. As far

as the American forms are concerned, there is nothing to be gained by continuing to treat them as variants of European species. The structural differences that mark most of our representatives which have been assigned to the *scabrinodis* complex are more distinct than those which delimit European representatives now treated as separate species. There is no reason to question the propriety of giving specific status to *sabuleti* and *schenki*, but there is every reason to doubt that anything is gained by trying to assign our American forms to one or the other of these two species. To do so not only misrepresents the status of our forms but adds unjustified complications for those who are striving to arrive at satisfactory means for delimiting the European species. It may be admitted that if and when an altogether satisfactory taxonomy can be worked out for Myrmica, it may be possible to relate some of our forms to European species. But until that time we lose rather than gain by attempting such relationships. For the above reason I have made no attempt in the present work to assign any North American representative to *sabuleti* or to *schenki*. There are good reasons why *americana*, *hamulata* and *monticola* may be treated as species in their own right. I have also given specific status to *emeryana*, although this insect, and its subspecies *tahoensis*, is very close to the European *schenki*.

Even so, it must not be thought that this treatment makes it easy to handle our forms of Myrmica. It helps to recognize that many of the species in this genus differ very slightly. It helps to recognize the valuable characteristics which may be found in the male. But neither of these realizations eliminate the difficulties inherent in the taxonomy of this formidable group. Perhaps the ultimate solution lies in the structure of the male genitalia. Dr. Neal Weber, who very generously allowed me access to his unpublished monograph on Myrmica, believes that this is the case. For the present, however, we must deal with this situation as best we can and avoid complicating it any further. As things are now it is utterly futile to describe new forms of Myrmica from a limited series of workers. We have carried one such form for half a century and are no wiser as to its true relationships than when it was first described in 1893. I refer to Emery's variety *detritinodis*. This insect was described from three workers and, while there is one specimen from the type series (marked as a cotype) in the Wheeler Collection at Harvard, it is impossible to determine the exact status of the insect. Since so few specimens are involved, it is pure conjecture as to what the definitive characteristics of *detritinodis* actually are. This circumstance prevents the association of any male with the insect. Thus Emery's *detritinodis* may be a form of *lobicornis*, it may belong to *schenki*, it may have affinities

with *emeryana*, or it may be a separate species. To avoid further confusion in the case of *detritinodis*, I propose that it be dropped as impossible of exact determination.

The genus Myrmica is more interesting from a distributional standpoint than because of its habits. The habits of our representatives are uniformly unspectacular. The insects prefer to nest in soil and frequently make use of a covering object above the nest. As a rule they are inoffensive ants, but one of them, *rubra laevinodis*, is pugnacious and can sting severely. The distribution of Myrmica is, on the other hand, most interesting. It appears to be the only large Holarctic genus which lacks xerophilous or subtropical representatives on this continent. A map showing the distribution of Myrmica in North America would reveal a widespread occurrence in Canada, with northern limits reaching Labrador in the east and Alaska in the west. Proceeding southward, one would find a restriction to areas of moderate to considerable elevation in both the eastern and the western United States. The genus is very poorly represented in the southern part of the Atlantic Coastal Plain and absent in the Gulf Coast and Texas areas. In the western mountains the genus will be found in abundance in the subalpine and Canadian zones, in decreasing numbers in the Transition zone and absent in the Sonoran areas at the base of the range. There is not a single North American representative which can be regarded as a xerophile, although a few forms prefer dry nest sites in the Transition zone. There are several other Holarctic genera in which a large proportion of the forms behave in a similar manner but there is no other member of this group of genera which shows this restriction more clearly. If this same characteristic were true of all species of Myrmica, it would be possible to conclude that the members of this genus are unable to tolerate regions marked by protracted periods of high temperature. But the genus has produced a number of species in the tropical portion of southeastern Asia, hence this explanation will scarcely apply. The absence of tropical and xerophilous species in the New World offers an attractive problem for those interested in distributional phenomena.

From what has been said on previous pages it should be clear that the key which follows must carry male characteristics as well as those of the worker if it is to be of any service in the case of certain species. This makes for a very clumsy sort of key and to reduce the complication as much as possible the definitive male characters have been included only where they were absolutely necessary. In most cases worker structure alone will give satisfactory separation.

Key to the species of Myrmica

1. Node of the petiole high, distinctly set off from the anterior and posterior peduncles and angular at the crest; the ventral surface of the petiole with a distinct, obtusely angular impression formed by the junction of the anterior and posterior peduncles ..... *wheeleri*
   Node of the petiole not distinctly set off from the anterior and posterior peduncles or, if so, it is low and much rounded above; ventral surface of the petiole straight or very feebly convex 2
2. Outer edge of the frontal lobe feebly convex throughout most of its length and fusing with the head without a marked posterior incision; frontal area distinct, not crossed by rugae, usually smooth and strongly shining 3
   Outer edge of the frontal lobe strongly convex or angular in front, or deeply incised behind, or both; frontal area obscured by rugae, never completely smooth and shining 4
3. Antennal scapes extending well beyond the occipital margin; epinotal spines at least two-thirds as long as the distance which separates their tips ..... *rubra* subsp. *laevinodis*
   Antennal scapes barely reaching the occipital margin; epinotum armed with two short, triangular teeth ..... *rubra* subsp. *champlaini*
4. Frontal lobes narrow, scarcely or not at all projecting above the antennal fossae; the insertions of the antennae exposed when the head is viewed from above ..... *spatulata*
   Frontal lobes strongly projecting out over the antennal fossae; the insertions of the antennae hidden when the head is viewed from above ... 5
5. Antennal scape gradually and evenly bent at the base, the upper surface never forming a right angle at the bend; the lamina, if present, forming a low and inconspicuous ridge at the side of the bend and never prolonged onto the upper surface of the scape 6
   Antennal scape suddenly bent at the base, the upper surface forming a right angle; lamina always present and of varying shapes but never absent from the upper surface of the scape 11
6. Basal face of the epinotum abruptly depressed below the level of the mesonotum; abdomen with numerous coarse punctures 7
   Basal face of the epinotum forming a descending slope with the dorsum of the mesonotum which is broken only by the impression at the meso-epinotal suture; abdomen with fine punctures 8
7. Antennal scapes surpassing the occipital margin by an amount equal to their greatest thickness; epinotal spines about one and one-half times as long as the distance which separates their bases and slightly deflected downward; color piceous brown; length 4.0–4.7 mm. (antennal scape of the male as long as the following six segments taken together) ..... *punctiventris*
   Antennal scapes barely surpassing the occipital margin; epinotal spines only slightly longer than the distance which separates their bases and not deflected downward; color brownish yellow; length 3.5–4.0 mm. (antennal scape of the male as long as the following two segments taken together) *pinetorum*

8. Lateral margins of the frontal lobes strongly angular, thick and slightly but definitely deflected downward (antennal scapes of the male not longer than the three following segments taken together and straight at the base) 9
Lateral margins of the frontal lobes rounded, thin and moderately to strongly elevated (antennal scape of the male slightly bent at the base and as long as the following four or five segments taken together) 10
9. Postpetiole with a shining dorsal area which is largely free from rugae; average size of workers 3.5 mm ..... *brevinodis* subsp. *kuschei*
Postpetiole ordinarily covered with rugae, rarely with a dorsal area free from rugae but in such cases this area is not shining; average size of workers at least 4.5 mm ..... *brevinodis*
10. Color orange yellow; epinotal spines slightly less than one-half as long as the distance which separates their tips ..... *brevispinosa*
Color dark brown; epinotal spines more than one-half as long as the distance which separates their tips ..... *brevispinosa* subsp. *discontinua*
11. The bend of the antennal scape with a large, thick lobose lamina which extends backward along the basal third of the scape ..... *monticola*
The bend of the antennal scape with a small transverse lamina or with a thin lamina which surrounds the bend like a collar and does not extend backward along the basal third of the scape 12
12. Ventral surface of the postpetiole seen in profile flat or nearly so and not forming a projection in front (antennal scapes of the male as long or longer than the following four segments taken together and straight at the base) ..... *americana*
Ventral surface of the postpetiole seen in profile convex or forming a prominent anterior projection which thrusts forward under the anterior peduncle (antennal scapes of the male bent at the base or if straight they are distinctly shorter than the above) 13
13. Lamina of the antennal scape forming a high, semicircular welt which surrounds the scape at the bend (antennal scape of the male bent at the base and usually shorter, never longer, than the three following segments taken together) 14
Lamina of the antennal scape not forming a high, semicircular welt (antennal scape of the male straight at the base or if bent its length is equal to the following five segments taken together) 15
14. Lamina of the antennal scape under-cut on its inner face so that the edge forms a distinct hook ..... *hamulata*
Lamina of the antennal scape without a hook on its inner face .....
hamulata subsp. *trullicornis*
15. Lamina of the antennal scape small and diagonally transverse on the upper surface of the scape but continued as a prominent transparent flange along the inner surface of that part of the scape that lies below the bend (antennal scape of the male straight at the base and as long as the three following segments taken together) ..... *emeryana*
Lamina not forming a prominent median flange as above or if a small median flange is present the lamina is not transverse on the upper surface of the scape 16

16. Epinotal spines slightly but distinctly bent downward; thorax reddish yellow, head and gaster piceous; (antennal scape of the male straight at the base and as long as the following three segments taken together).... *emeryana* subsp. *tahoensis*

Epinotal spines straight; color not as above (antennal scape of the male bent at the base and at least as long as the following five segments taken together).....17

17. Antennal lamina encircling the bend of the scape in the form of a spoon-like or saucer-like flange (antennal scape in the male abruptly bent at the base with the upper surface distinctly angulate at the bend; epinotal spines of the male well-developed, the epinotum with prominent rugae)..... *lobicornis* subsp. *lobifrons*

Antennal lamina small and transverse and forming an angular tooth-like projection on the inner side of the bend (antennal scape of the male gradually bent at the base and not forming a distinct angle at the bend; the epinotal spines of the male reduced to rounded angles, the rugae of the epinotum very feeble or lacking)..... *lobicornis* subsp. *fracticornis*

1. Myrmica americana Weber

M. sabuleti subsp. *americana* Weber, Lloydia, Vol. 2, p. 144 (1939) ♀ ♀ ♂.
Type loc: Colebrook, Connecticut. Types: M.C.Z., Coll. N. A. Weber.
Range: eastern Canada and the northeastern United States west to the Rocky Mountains. The insect also occurs in the mountains of Utah.

Although Dr. Weber has treated *americana* as a subspecies of *sabuleti*, I believe that it should be recognized as a separate species. The scape of the male of *americana* is as long as the following four or five segments together and in this respect the insect resembles *lobicornis*. But the scape of the male of *americana* is straight at the base while that of *lobicornis* is bent. The lobe at the base of the scape in the worker of *americana* is not particularly distinctive and a better separatory character seems to be the straight lower border of the postpetiole. But, as Dr. Weber has pointed out, there is a certain amount of variation even in this latter character, hence for satisfactory determination the male should be present.

Before leaving *americana* I wish to comment on certain ecological characteristics of this insect which seem to need elucidation. In 1944 Buren expressed the opinion that *americana* is a 'prairie form'. This contention seems to be clearly negated not only by some of Mr. Buren's own records but by many of the records coming from the very extensive range occupied by *americana*. For *americana* not only occurs in prairie regions but in several other types of environment

as well. In the east it has been frequently taken in open woodlands and it is my experience that in the Rocky Mountain area it usually occurs in foothill canyons at elevations of about 6000 feet. I mention this fact because it shows clearly the difficulties of trying to establish an 'ecological subspecies' unless one is dealing with the fauna of a very limited region.

2. Myrmica brevinodis Emery

In the present work so many changes have been made in the complex of forms previously assigned to *brevinodis* that it seems advisable to present a single account of them here. *M. brevinodis* is an abundant, widely distributed and highly variable insect and it is not surprising that a number of subspecific variants should have been attached to it. To date ten described forms have been so treated. But if these forms are examined carefully, it is clear that they fall into two separate categories. Some of them correspond exactly with *brevinodis* except for very minor differences of color and sculpture. These forms possess a male in which the antennal scape is short and straight. The second group of forms differs from *brevinodis* in the character of the frontal lobes (see key) and their male has a long scape which is curved at the base. It would appear, therefore, that two species have been included in *brevinodis*. To rectify this situation I propose to recognize *brevispinosa* as a separate species. With *brevispinosa* must go *decedens*, which is a synonym of that species. I believe that *discontinua* is a subspecies of *brevispinosa* and not of *brevinodis*. The description of *discontinua* was based primarily on the worker but Dr. Weber mentioned a male of this form which was 'very much like a *fracticornis* male'. We may assume therefore that the male of *discontinua* shows the long scapes of *brevispinosa* and not the short ones of *brevinodis*. Of the seven variants which belong to *brevinodis* only one, the Alaskan *kuschei*, appears to have the characteristics of a geographical race. The range of *kuschei* apparently lies at low elevations along the Alaskan seaboard. In those latitudes the typical *brevinodis* occurs at inland stations where the elevation is somewhat greater. It is my opinion that the form which Wheeler called *alaskensis* is an intergrade between the typical *brevinodis* and the subspecies *kuschei* It is unfortunate that it is necessary to synonymize the varieties *canadensis, frigida, subalpina, sulcinodoides* and *whymperi* with *brevinodis* but a study of a large quantity of material covering all these variants has shown the impossibility of satisfactory separation on either a structural or a distributional basis. In every

case the structural distinctions involved consist of exceedingly slight differences in sculpture, pilosity or color. Not only are these differences remarkably inconsequential but it is only rarely that they hold over an entire nest series. As a result this complex of forms presents a completely intergrading character which defeats successful handling of the several variants. We could, perhaps, do something with the group if any of its members showed distinctive distributional characteristics. But the little of this that exists is of such a general nature that it is of no help as a means for delimiting the variants as geographical races. In the west the varieties *subalpina, sulcinodoides* and *frigida* have occasionally been taken together and the first two forms regularly occur in the same stations. In eastern Canada *frigida* and *canadensis* have ranges that are largely coincidental. In 1907 Wheeler reported an elevational difference in the case of *sulcinodoides* and *subalpina*. At that time he believed that *subalpina* replaced *sulcinodoides* at higher elevations. The much more extensive data which Wheeler published ten years later completely contradicted this view and showed that the two forms are not marked by any difference in their elevational tolerance. My own experience in the field has repeatedly confirmed this fact. I would like to repeat here what was stated on an earlier page. It seems much more important to strive for a sound concept of the specific characteristics of *brevinodis* than to waste energy on the hopeless task of trying to sort out and name the minor fluctuations which occur in it. There follows the synonymy of *Myrmica brevinodis* Emery:

M. rubra subsp. *brevinodis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 312 (1895) ♀ ♂; Wheeler, Bull. Wis. Nat. Hist. Soc., Vol. 5, p. 74 (1907) ♀ ♀ ♂.

M. rubra subsp. *brevinodis* var. *canadensis* Wheeler, Ibid., Vol. 5, p. 76 (1907) ♀ ♀ ♂.

M. rubra subsp. *brevinodis* var. *frigida* Forel, Trans. Ent. Soc. Lond., p. 699 (1902) ♀; Wheeler, Bull. Wis. Nat. Hist. Soc., Vol. 5, p. 78 (1907) ♀.

M. rubra subsp. *brevinodis* var. *subalpina* Wheeler, Ibid., Vol. 5, p. 77 (1907) ♀ ♀ ♂.

M. rubra subsp. *brevinodis* var. *sulcinodoides* Emery, Zool. Jahrb. Syst., Vol. 8, p. 313 (1895) ♀; Wheeler, Bull. Wis. Nat. Hist. Soc., Vol. 5, p. 75 (1907) ♀ ♀ ♂.

M. rubra subsp. *brevinodis* var. *whymperi* Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 154 (1904) ♀; Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 49, p. 215 (1913).

Type loc: Salt Lake, Utah. Types: none in this country.

Range: Labrador south to New Jersey and westward through the northern United States and Canada to the Pacific northwest and southern Alaska. A southern extension in the Rocky Mountain Region extends into the mountains of New Mexico.

3. Myrmica brevinodis kuschei Wheeler

M. brevinodis subsp. *kuschei* Wheeler, Bull. Mus. Comp. Zoöl., Vol. 61, p. 17 (1917) ♀ ♀.
M. brevinodis var. *alaskensis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 503 (1917) ♀.
Type loc: Ketchikan, Alaska. Types: M.C.Z.
Range: known only from Alaska.

Although *kuschei* was described after *alaskensis*, it seems admissible that the newer name should stand. The variety *alaskensis* is an obvious intergrade between *kuschei* and the typical *brevinodis*. Since *kuschei* appears to be a valid geographical race it, and not *alaskensis*, should be the form whose name is retained.

4. Myrmica brevispinosa Wheeler

M. rubra subsp. *brevinodis* var. *brevispinosa* Wheeler, Bull. Wis. Nat. Hist. Soc., Vol. 5, p. 74 (1907) ♀ ♀ ♂.
M. brevinodis var. *decedens* Wheeler, Ibid., Vol. 5, p. 75 (1907) ♀ ♂.
Type loc: Cheyenne Canyon, Colorado (by present designation).
Types: M.C.Z.
Range: northern New Mexico to southern Alberta, west to Idaho and eastward to Nebraska and North Dakota.

Although the structural characters which separate *brevispinosa* and *brevinodis* are more striking in the male than in the worker, there would seem to be no doubt that this insect deserves specific status. The antennal scape of the male of *brevispinosa* is certainly no less characteristic (see key) than that of other forms which have been given specific rank on this basis. The frontal lobes of the worker of *brevispinosa* are entirely different from those of *brevinodis* (see key). The scape of the worker also shows slight but rather significant differences. In the worker of *brevinodis* the curved basal portion of the scape is flattened dorso-ventrally and lacks any trace of carinula. In *brevispinosa* the flattening is in a lateral plane and there is a feeble but distinct carinula which runs along the side of the curved portion. The most obvious difference in the worker is its much shorter epinotal spines but this characteristic is unreliable because of the tendency of the spines to vary in length. The distribution of *brevispinosa* is more distinct from that of *brevinodis* than the records seem to indicate. The latter species has a wide elevational tolerance which enables it to occupy stations in several life zones. The distribution of *brevispinosa,*

on the other hand, is limited to the transition zone. It prefers to nest in gravelly stream bottoms and is one of the most thermophilic members of the genus.

I have synonymized the variety *decedens* with *brevispinosa*. Wheeler distinguished *decedens* on the basis of the slightly longer epinotal spines of the worker and the slightly longer scape of the male. The fluctuation in any large series of specimens of *brevispinosa* will more than include such slight differences.

5. Myrmica brevispinosa discontinua Weber

M. brevinodis subsp. *discontinua* Weber, Lloydia, Vol. 2, No. 2, p. 150 (1939) ♀.
Type loc: Florissant, Colorado. Types: M.C.Z., Coll. Weber.
Range: Newfoundland and Nova Scotia west to the mountains of Colorado and Wyoming.

If I am correct in my view of *discontinua*, the insect is an eastern race of *brevispinosa*. The ranges of the two forms meet in the Rocky Mountain Region and in adjacent states to the east. The reasons for transferring *discontinua* to *brevispinosa* have been given in the introduction to *brevinodis*.

6. Myrmica emeryana Forel

M. scabrinodis subsp. *schenki* var. *emeryana* Forel, Deutsche Ent. Zeitschr., p. 617 (1914) ♀ ♀ ♂.
Type loc: no definite locality cited, by inference North Carolina.
Types: none in this country.
Range: Newfoundland to Georgia and west to the Rocky Mountains. The western records are comparatively rare.

Although this insect is closely related to the European *schenki* I believe that it is better to treat it as a separate species, at least until the relationship of the American forms to those of Europe is placed on a sounder basis than exists at present. The characteristics of the scape of the male will readily distinguish *emeryana* from related American species. The scape is straight at the base and as long as the following three segments taken together. No other American species except *brevinodis* shows a comparable condition and there is little likelihood for confusion between *emeryana* and *brevinodis* because of the notable differences in the structure of the scape of the worker.

7. Myrmica emeryana tahoensis Wheeler

M. scabrinodis subsp. *schenki* var. *tahoensis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 504 (1917) ♀ ♀ ♂.
Type loc: Lake Tahoe, California. Types: M.C.Z., Coll. W. S. Creighton.
Range: British Columbia south to the Sierras of California and the central Rockies of Montana and Wyoming. The insect also occurs in the mountains of Arizona, Nevada and Utah.

It is difficult to say exactly where the range of *tahoensis* meets that of the typical *emeryana* because of the scarcity of the latter insect in the Rockies. There is, however, some evidence of intergradation in specimens coming from Montana, Utah and eastern Nevada.

8. Myrmica hamulata Weber

M. sabuleti subsp. *hamulata* Weber, Lloydia, Vol. 2, No. 2, p. 146 (1939) ♀ ♀ ♂.
Type loc: Hayne's Canyon (8000'), Sacramento Mountains, New Mexico.
Types: M.C.Z., Coll. N. A. Weber.
Range: mountains of New Mexico, Colorado and Utah.

The characteristics of both worker and male in *hamulata* are so clearly distinct that there would seem to be no question concerning the propriety of treating this insect as a separate species. The peculiar, high, thin, hooked flange on the antennal scape of the worker is unique. The antennal scape of the male is curved at the base and very short. Dr. Weber gives the length of the scape as equal to the following two or three segments taken together. It would seem, however, that the scape is more often equal in length to the first two funicular segments than to the first three. At least this has been the case with all the males which the writer has examined. I have taken this insect twice in the field. To judge from these two records it prefers to nest on upland plateaus at elevations from 7000–8000 feet.

9. Myrmica hamulata trullicornis Buren

M. sabuleti subsp. *trullicornis* Buren, Iowa State Coll. Jour. Sci., Vol. 18, No. 3, p. 281 (1944) ♀ ♀.
Type loc: Ames, Iowa. Types: Coll. W. F. Buren, Paratypes: U.S.N.M., Coll. Iowa State College, Coll. W. S. Creighton.
Range: known from stations in Iowa only.

The exact status of *trullicornis* is problematical and will remain so until a male can be associated with the workers. It has little rela-

tionship with *americana*, in my opinion, although Buren claims to have found intergrades connecting the two. The high, thin almost vertical flange on the scape of worker of *trullicornis* certainly suggests a relationship with *hamulata*. But the flange in *trullicornis* is not as extensive as that of *hamulata* and it lacks the distinct hook which is present on the inner face of the flange in *hamulata*. In this connection it is interesting to note that, in one of the two paratypes which Mr. Buren very kindly sent me, the mesial edge of the flange is slightly impressed at the base. The resulting overhang is far less pronounced than the hook in *hamulata*, indeed it cannot properly be regarded as being a hook at all, but at least the same tendency to produce a rearward projection from the flange seems to be present in both insects. I am ready to admit that to treat *trullicornis* as a subspecies of *hamulata* involves the hope that its range will subsequently be found to extend to the Rockies. But since we have to take the male of *trullicornis* on trust, we may also trust that the distribution will, when it is better known, prove in consonance with the above treatment.

10. Myrmica lobicornis fracticornis Emery

M. rubra subsp. *scabrinodis* var. *fracticornis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 313 (1895) ♀.

Type loc: Buffalo, New York (by present restriction). Types: M.C.Z.

Range: extensively distributed throughout Canada and the northern United States. A southern extension follows the Rocky Mountain Highlands into northern New Mexico. The insect is rare in the region west of the Rockies and seems to be entirely absent on the Pacific slope.

The status of *fracticornis* is difficult to evaluate. It can scarcely be regarded as an eastern race of *lobicornis*, for its range in the west is almost as extensive as that of *lobifrons*. But in the west it seems to occur at somewhat lower levels than does *lobifrons*. It would seem, therefore, that *fracticornis* is best regarded as a subspecies whose tolerance for lower elevations has enabled it to utilize stations in the east as well as in the west, while *lobifrons*, because of its restriction to high elevations, has a distribution limited to the western mountains. What appear to be intergrades between the two forms occur in many parts of the west.

11. Myrmica lobicornis lobifrons Pergande

M. sabuleti var. *lobifrons* Pergande, Proc. Acad. Sci. Wash., Vol. 2, p. 521 (1901) ♀.

M. scabrinodis var. *glacialis* Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 154 (1904) ♀.

M. scabrinodis subsp. *lobicornis* var. *glacialis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 504 (1917) ♀ ♀ ♂; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 61, No. 2, p. 21 (1917) ♀.

Type loc: Metlakahla, Alaska. Types: U.S.N.M., M.C.Z.

Range: mountains of Colorado and New Mexico north to Alaska. The insect also occurs in the mountains of Utah and Arizona. In the southern portions or its range *lobifrons* always occurs at high elevations. In Colorado it is rarely found below 8000 feet and usually occurs at much higher levels.

Wheeler has shown that Pergande's name *lobifrons* must take precedence over Forel's *glacialis*.

12. Myrmica monticola Wheeler

M. scabrinodis subsp. *schenki* var. *monticola* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 505 (1917) ♀ ♂.

M. sabuleti subsp. *nearctica* Weber, Lloydia, Vol. 2, No. 2, p. 148 (1939) ♀ ♀ ♂.

Type loc: Beuna Vista, Colorado. Types: M.C.Z.

Range: central Colorado north to Manitoba and east to North Dakota.

The short scape of the male and the peculiar flange on the scape of the worker clearly mark *monticola* as a separate species. The scape in the male is only a little longer than the two following joints taken together but it is straight at the base. This gives a distinction from the conditions found in *hamulata*, which also has a short scape but with a curved base. The peculiar lateral flange which extends well back along the base of the scape in the worker is unique.

A singular and very confusing situation has arisen in the case of *monticola*, because of its redescription by Weber as *nearctica*. At first I was inclined to doubt that this could be the case for, since Dr. Weber was working with the Wheeler Collection when he described *nearctica*, it seemed very improbable that the two could be the same. However, I now not only believe that the two are the same but also that some of the specimens in the second syntype series cited by Weber for *nearctica* are actually a part of the type series of *monticola*. It may be recalled that these specimens were taken by Wheeler at Buena Vista, Colorado, the type locality of *monticola*. The difficulties involved in this matter are much more serious than might be supposed for, if I am correct as to what happened, they will not be resolved by a comparison of the type material of *monticola* and *nearctica* at present in the Wheeler Collection. During the last years of Dr. Wheeler's life his collection was subjected to a great deal of handling. In 1928 it was transferred from the Bussey Institution to the Museum of Comparative Zoölogy. Later the specimens were taken from their

original boxes and placed in larger museum cases. Still later the collection was divided with the American Museum of Natural History. The handling of this vast aggregation of specimens was successfully accomplished through the care and unremitting effort of Mr. Nathan Banks. But in view of the large amount of material involved it is not surprising that some slight confusion should have resulted. I know from first hand observation that in a few instances type series have become mixed. It may be surmised that this was the case with the type series of *monticola*. I believe that Dr. Weber found two distinct forms represented in the type series of *monticola* and that he separated the two. I further believe that the specimens which Dr. Weber regarded as syntypes of *nearctica* were actually types or at least a part of the type series of *monticola*. This belief is based on the fact that before the Wheeler Collection left the Bussey Institution Dr. Wheeler gave me many named specimens from it. Among these were representatives of *monticola* which he had taken at Cheyenne Canyon, Colorado, (a part of what is now the second syntype series of *nearctica*). Thus whatever the situation may be at present in the case of the type series of *monticola* and *nearctica*, I feel reasonably certain that the insect which Dr. Wheeler originally treated as *monticola* is the same as that which Dr. Weber has called *nearctica*. I am aware that much of what has been said above is conjectural but until it can be shown that the original *monticola* was something different from *nearctica*, I prefer to treat the latter insect as a synonym of *monticola*.

13. Myrmica pinetorum Wheeler

M. punctiventris subsp. *pinetorum* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 348 (1905) ♀.
Type loc: Lakehurst, New Jersey. Types: M.C.Z.
Range: southern New England to North Carolina and west to Ohio.

Although *pinetorum* has hitherto been regarded as a subspecies of *punctiventris* the two are unusually distinct. Indeed, there is little other than the punctuation of the gaster in which the two insects exactly correspond. As the ranges of the two are largely coincidental, *pinetorum* cannot be considered as a subspecies. The structural distinction which it shows is quite enough to give it specific status.

14. Myrmica punctiventris Roger

M. punctiventris Roger, Berl. Ent. Zeitschr., Vol. 7, p. 190 (1863) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 450 (1886) ♀ ♀; Emery, Zool.

Jahrb. Syst., Vol. 8, p. 312 (1895) ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 544, pl. 5, fig. 18 (1947) ♀.
Type loc: North America. Types: none in this country.
Range: southern New England south to Tennessee and west to Iowa.

15. Myrmica rubra champlaini Forel

(Introduced)

M. rubra subsp. *champlaini* Forel, Mitt. Natur. Mus. Hamburg, Vol. 18, p. 80 (1901) ♀.
Type loc: Quebec, Canada. Types: none in this country.
Range: known only from eastern Canada.

The writer regrets that it is necessary to refer to the peculiar series of events that have beset the forms of *M. rubra* which have been taken in Canada and the United States. Most myrmecologists have let this matter alone, and they have been wise to do so, for the whole situation is thoroughly exasperating. In 1900, when Forel was in Quebec, he took specimens from a nest 'at the edge of a meadow path near the port' of the ant that he named *M. rubra champlaini* in the following year. At this same time he described a second race, *M. rubra neolaevinodis*, from specimens taken from iris rhizomes at the Plant Quarantine Station at Hamburg, Germany. These iris rhizomes had been shipped to Germany by way of New York, hence Forel cited New York as the type locality for *neolaevinodis*. In 1906 Wheeler described a variety of *M. rubra*, which he called *bruesi*, from specimens taken at Woods Hole, Massachusetts. Since Forel had claimed that both *champlaini* and *neolaevinodis* are endemic North American ants, Wheeler at first took the same view of the variety *bruesi*. But Wheeler was doubtful of this from the start and by 1908 he had reconsidered the matter and abandoned Forel's view. During the interval between 1906 and 1908 Wheeler had taken other specimens in Massachusetts which were identical with the European *laevinodis*. As a result, he was prepared to believe that these specimens, and those of the variety *bruesi* as well, had reached this country by importation from Europe. Wheeler also felt that this same explanation applied to *champlaini*, and the fact that this insect was taken in close proximity to the docks in Quebec favors this view. In the case of *neolaevinodis* Wheeler refused to believe that this insect is a native of North America at all. He pointed out that Forel could not be sure that the type series of *neolaevinodis* came from New York and that it seemed peculiar that there were no records of this insect, or any form of *rubra*, from the New York area if the insect were actually a native of that region.

Wheeler cited his failure to discover *neolaevinodis* in the New York region and I would like to reinforce his experience in this matter with my own. Where Wheeler collected in and around New York for six years, I have done so for sixteen. Like Wheeler I have never found any evidence that *rubra* occurs in the New York region.

If Wheeler had held to the position which he advocated in 1908, we would have been well on the way to a satisfactory solution of this problem. Both *laevinodis* and *champlaini* could have been treated as introduced forms and *neolaevinodis* could have been dropped from the list of North American ants. Instead, Wheeler reversed himself completely in 1917 by including all three forms in the list of native eastern species which formed a part of his study on the mountain ants of western North America. I cannot explain this extraordinary reversal and I certainly cannot subscribe to it. For that matter I do not think that Wheeler himself did so. I consider that the inclusion of the three forms in the above list was accidental and not an indication that Wheeler had changed his opinion as to their status in our ant fauna. Except for the fact that I have treated the variety *bruesi* as a synonym of *laevinodis*, I propose, in this volume, to adhere to the view which Wheeler published in 1908. Under this plan *champlaini* and *laevinodis* will be treated as introduced forms and *neolaevinodis* will be dropped from the roster of North American ants.

16. Myrmica rubra laevinodis Nylander

(Introduced)

M. laevinodis Nylander, Act. Soc. Sci. Fennicae, Vol. 2, p. 927, pl. 18, fig. 5 (1846) ☿ ♀ ♂; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 5, p. 402 (1855); Nylander, Ann. Sc. Nat. Zool. (4), Vol. 5, p. 78 (1856); Meinert, Natur. Afh. Dansk. Vid. Selsk (5), Vol. 5, p. 51 (1861); Mayr, Europ. Formicid, p. 64 (1861); E. André, Spec. Hym. Europe, Vol. 2, p. 316, pl. 21, figs. 1–8 (1882); Ruzsky, Formic. Imp. Rossici, Vol. 1, p. 655, fig. 165 (1905) ☿ ♀ ♂; Donisthorpe, Brit. Ants, p. 110 (1915) ☿ ♀ ♂.

M. rubra subsp. *laevinodis* Forel, Fourmis Suisse, p. 76 (1874) ☿ ♀ ♂; Emery, Deutsche Ent. Zeitschr, p. 170, fig. 3, 4 (1908) ☿ ♀ ♂; Forel, Fauna Insect Helvet. Hym. Form., p. 28 (1915); Emery, Bull. Soc. Ent. Ital., Vol. 47, p. 119, fig. 17, 21a (1916) ☿ ♀ ♂.

M. rubra laevinodis var. *bruesi* Wheeler, Psyche, Vol. 13, p. 38 (1906) ☿; Wheeler, Jour. Econ. Ent., Vol. 1, p. 338 (1908) ☿.

Type loc: Denmark. Types: none in this country.

Range: (in the United States) eastern Massachusetts.

Although this ant is now firmly established in eastern Massachusetts, there seems to be little evidence that it is spreading out of that

area. In 1928 the insect was abundant in Forest Hills and outlying parts of Boston. Unlike most other species of Myrmica, it has a powerful and painful sting and does not hesitate to use it.

17. Myrmica spatulata M. R. Smith

M. schenki var. *spatulata* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 23, p. 566 (1930) ♀ ♀.
Type loc: Starkville, Mississippi. Types: Coll. M. R. Smith, M.C.Z.
Range: Mississippi to Illinois.

Smith described this insect as a variety of *schenki*. The male appears to be unknown but, even in its absence, there are so many outstanding characters shown by the worker that it may be given specific status. The very large, spatulate lamina on the antennal scape which gave this insect its name is exceedingly striking when fully developed. Unfortunately the lamina is prone to wide variation in size. For this reason I have utilized the equally striking and much more constant structure of the frontal lobes (see key) as a means for recognizing this species.

18. Myrmica wheeleri Weber

M. wheeleri Weber, Lloydia, Vol. 2, p. 150 (1939) ♀ ♀ ♂.
Type loc: Mt. Lemmon and Mt. Stratton, Arizona. Cotypes: M.C.Z., Coll. N. A. Weber.
Range: known only from type material.

As Weber pointed out in his original description of *wheeleri*, this insect resembles *brevispinosa* in many respects. It differs from *brevispinosa* in its slightly down-curved spines and in the very smooth and shining frontal area. The structure of the petiole is, however, the outstanding feature of *wheeleri* (see key). In particular the deep, angular impression in the ventral surface of the petiole separates this species from all other North American representatives of Myrmica.

Genus Manica Jurine

(Plate 15, figures 1–4)

In a paper published in 1947 Dr. Neal Weber has proposed to accord Manica generic status. The writer fully agrees with this view and for this reason the following paragraph, which was written before Dr. Weber's proposal appeared, has been left in its original form.

As far as the North American representatives of Manica are concerned there is little to suggest intergradation with the members of the genus Myrmica. It must be admitted, however, that the European *Manica rubida* is less distinct than might be wished. This species usually possesses an epinotum in which the angle between the basal and declivious faces is provided with low, flange-like projections. These projections are certainly not spines but, on the other hand, there are several representatives of Myrmica in which the epinotal spines are reduced to angles. If the unarmed epinotum were the only feature which distinguishes Manica from Myrmica it would scarcely be possible to defend generic status for Manica. But there are other differences which together produce an insect quite distinct from those belonging to the genus Myrmica. The mesonotum in Manica is somewhat strangulate, which gives the thorax the appearance of a thick-waisted hourglass when seen from above. In Myrmica the impression at the mesoepinotal suture is usually much less extensive and largely limited to the upper portion of the thorax. Because of this the thorax of Myrmica does not have an hourglass appearance when seen from above. In Manica each mandible bears a prominent terminal and subterminal tooth, with the remainder of the masticatory margin unarmed or bearing only fine denticles. In Myrmica the mandible usually bears a second subterminal tooth and the rest of the masticatory margin bears a row of well-developed denticles which increase in size toward the apex. The node of the petiole in Manica is evenly rounded above. This condition rarely occurs in Myrmica, where the node is marked by an angular crest. The sculpture of Manica is much less rugose than that of Myrmica. This is particularly noticeable on the thorax where the rugae occur as parallel lines. In Myrmica the thoracic rugae (and usually those elsewhere as well) are strongly reticulate, even in the smoother forms. The few males of Manica which the writer has seen all have very long and well-developed mandibles. The ocelli are set well back on the head, the laterals lying at the level of the occiput. This gives the head of the Manica male a totally different appearance from that of the male of Myrmica. For in the male of Myrmica the mandibles are small (often strap-like) and the ocelli are set in front of the occipital level.

The nomenclatorial tangle concerned with the genus Manica has been needlessly involved. In 1911 Wheeler published a list of the genera and subgenera of ants and designated a type for each group in which there had been no previous selection of a genotype. In this list Jurine's Manica appeared as a synonym of Myrmica. Wheeler designated *Formica rubida* Latreille as the genotype of Manica. There is no reason to question this choice, since it had been granted for years

that Jurine's *Manica rubida* was identical with Latreille's species bearing the same name. In 1914, however, Wheeler revised his opinion concerning the status of *rubida* and the North American species allied to it, and proposed to give the group subgeneric rank under the name Oreomyrma. As he designated *rubida* as the subgenotype of Oreomyrma, one must suppose that he had forgotten his previous designation of this same species as the genotype of Manica. Earlier that same year (1914) Forel had published the description of a species which he called *calderoni*. Forel regarded this insect as belonging to a new subgenus of Aphaenogaster, for which he proposed the name Neomyrma. In the following year Wheeler was able to show that *calderoni* is a synonym of *bradleyi*. But while Wheeler's specific name *bradleyi* had precedence, his subgeneric name Oreomyrma did not. Wheeler, therefore, replaced his subgeneric name with Forel's Neomyrma and shifted the subgenotype to *bradleyi*. There is no telling how much longer this nomenclatorial juggling would have continued had not Emery cut through the tangle and restored the rightful name, Manica, to the group.

With the exception of *parasitica*, which may prove to be a temporary social parasite, there is little out of the ordinary in the habits of our species of Manica. The colonies are never very populous and rarely contain more than a few hundred individuals. The nests of *bradleyi* seem to be larger than those of the other species. It is possible that *aldrichi* may prefer to nest in open woods but, if so, this is an exception to the general rule that these insects select fully exposed nest sites. Most of the species build obscure nests in soil that is often very harsh and gravelly. Only *bradleyi* seems to prefer to nest under stones. According to Mallis (1941) this species sometimes constructs a regular low cone or disc around the nest entrance. I believe, however, that this must be regarded as exceptional. I have seen so many nests of *bradleyi* without any trace of excavated material above them that it is impossible to believe that this species regularly constructs a mound above the nest.

The key which follows differs considerably from that given in Wheeler's 1914 study of Manica. Wheeler's key was based largely on distinctions of color. While some of our species of Manica can be recognized by their characteristic color, it seems best to subordinate such color differences to the structural features which mark the species. These are not only more reliable than color but, since they are perfectly satisfactory as key characters, there is no reason why they should not be used. It seems well to note that the figure which Wheeler gave for *mutica* in 1914 shows the postpetiole of that insect without a trace of ventral projection. Such individuals occur in almost every colony but

this is not the form of the postpetiole most commonly encountered. Much more often the postpetiole of *mutica* shows a small, rounded, ventral projection which occupies the same position as the more prominent protuberances found in *aldrichi* and *hunteri*. In *mutica*, however, this projection is not only much smaller but it does not project forward as do those of the other two species.

Key to the species of Manica

1. Postpetiole with a very prominent, conical, ventral protuberance which projects forward beneath the posterior peduncle of the petiole.....2
   Postpetiole without a ventral protuberance or with a small, rounded, ventral projection which does not extend forward beneath the posterior peduncle of the petiole.....3
2. Antennal scape just reaching the occipital border; color clear yellow.... *aldrichi*
   Antennal scape surpassing the occipital border by an amount equal to its greatest thickness; color deep reddish orange.....*hunteri*
3. Posterior face of the node of the petiole in large part smooth and shining; at least the head and gaster piceous brown.....4
   Posterior face of the node of the petiole sculptured and opaque; the entire insect dull yellow or orange.....*mutica*
4. Thoracic sculpture feeble, the surface moderately to strongly shining; color uniform piceous brown.....*parasitica*
   Thoracic rugae coarse and prominent, the surface scarcely shining; head and gaster piceous brown, the thorax clear yellow.....*bradleyi*

1. Manica aldrichi (Wheeler)

Myrmica (*Oreomyrma*) *aldrichi* Wheeler, Psyche, Vol. 21, p. 120, fig. 1 b (1914) ♀.

Type loc: Moscow, Idaho. Types: M.C.Z.

Range: mountains of northern Idaho to the Cascade Range in Washington and Oregon.

Although this species is by no means rare its distribution seems to be very discontinuous. The writer has encountered it but once in the field. On that occasion the nest was situated in fairly open pine woods at an elevation of about 3000 feet.

2. Manica bradleyi (Wheeler)

Myrmica bradleyi Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 77 (1909) ♀.

Myrmica (*Oreomyrma*) *bradleyi* Wheeler, Psyche, Vol. 21, p. 119, fig. 1 e (1914) ♀; Wheeler, Ibidem, Vol. 22, p. 50 (1915) ♀.

Aphaenogaster (*Neomyrma*) *calderoni* Forel, Rev. Suisse Zool., Vol. 22, p. 275 (1914) ♀.
Type loc: Alta Meadow, Tulare Co., California. Types: M.C.Z.
Range: upland meadows of the California Sierras at elevations of 8500–9000 feet.

3. Manica hunteri (Wheeler)

Myrmica (*Oreomyrma*) *hunteri* Wheeler, Psyche, Vol. 21, p. 121, fig. 1 c (1914) ♀.
Type loc: Madison River, Beaver Creek, Montana (7500′) Types: M.C.Z.
Range: mountains of southwestern Montana to the ranges of northeastern Nevada.

The preference of *hunteri* for nest sites at considerable elevations is well marked. In the southern part of its range the insect usually nests at elevations around 8000 feet. It seems never to descend below 7000 feet even in the northern part of its range.

4. Manica mutica (Emery)

Myrmica mutica Emery, Zool. Jahrb. Syst., Vol. 8, p. 311 (1895) ♀.
Myrmica (*Oreomyrma*) *mutica* Wheeler, Psyche, Vol. 21, p. 119, fig. 1 d (1914) ♀ ♀ ♂.
Myrmica (*Manica*) *mutica* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 544, pl. 5, fig. 19 (1947) ♀.
Type loc: Denver, Colorado. Types: none in this country.
Range: eastern slopes of the Rocky Mountains from central Colorado to southern Alberta and thence west to the Sierras in California and the Pacific Coast in Washington and southern British Columbia.

The range of *mutica* is far larger than that of any of our other species It also seems to have a somewhat more continuous distribution, which is probably due to the fact that it occurs at lower levels than do some of the other species. In Colorado it is rarely found above 5000 feet and seems to prefer foot hill areas, where the nests are constructed in fully exposed situations and usually in coarse gravelly soil. While the sting of *mutica* is exceedingly painful, the insect is not particularly aggressive and will usually avoid using its sting unless the nest is disturbed.

5. Manica parasitica (Creighton)

Myrmica (*Manica*) *parasitica* Creighton, Psyche, Vol. 41, No. 4, p. 185 (1934) ♀.
Type loc: Polly Dome, Yosemite National Park, California (8600′).

Types: M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.
Host: *M. bradleyi.*

It is unfortunate that no additional material of *parasitica* has been secured for we need more information on this species. There can be no question that the insect is parasitic in the nests of *bradleyi* but as to whether this relationship is a permanent one or a matter of temporary social parasitism cannot be determined at present.

Genus POGONOMYRMEX Mayr

(Plate 16, figures 1–4)

In the present volume it has so often been necessary to discuss taxonomic problems connected with genera and subgenera that it is a pleasure to note that this is unnecessary in the case of Pogonomyrmex. Since 1868, when Mayr first set up the genus, there has been good agreement on the group. This is not to say that Pogonomyrmex lacks taxonomic problems but these are on a specific or infraspecific level. We may, therefore, go directly to the habits of these interesting ants.

The ants which belong to Pogonomyrmex have always attracted an unusual amount of popular interest. Some of this, it must be admitted, is of a rather gruesome character. There is a persistent belief that in the days when the West was wilder than it is now, Indians would sometimes stake out a human victim across a nest of Pogonomyrmex. If this was actually done, it would be hard to imagine a more excruciating death. The sting of most species of Pogonomyrmex is excessively painful. It is not a localized reaction, like that of a bee sting, but one which spreads along the lymph channels and often causes intense discomfort in the lymph glands of the axil or groin long after the original pain of the sting has ceased.

In a more cheerful vein there is the celebrated story of Lincecum and his 'ant rice' (1862). It was Lincecum's contention that Pogonomyrmex cultivates a species of grass which it harvests and stores in the nest over winter and replants the following spring. Many of Lincecum's observations were correct and it is unfortunate that the deductions which he drew from them were not more cautious, for he almost had his story right. However his erroneous view found eminent sponsors, among them Charles Darwin, and this gave to it a standing which was a long time in being dispelled. It was not until Wheeler began his studies on these ants at the beginning of the present century that the matter was put on a sound basis.

The habits of most of our species of Pogonomyrmex appear to be fairly uniform. Although the size of the colony and the shape of the mound are subject to considerable variation, there is good reason to suppose that all the species depend largely on the seeds of plants for their main dietary staple. At certain seasons the seeds are brought to the nest in such quantities that a large surplus accumulates in the nest chambers. As Wheeler has shown (1910) the workers of Pogonomyrmex do not damage the seeds to prevent them from germinating. During periods of unusual wetness a considerable portion of the stored seeds may sprout. The ants remove these seedlings and discard them on the kitchen midden which surrounds the nest. Many of the discarded seedlings take root and there thus grows up around the nest an "ant garden" whose origin so sadly misled Lincecum. It may be doubted that any member of this genus is limited to an exclusively graminicolous diet. Like most ants they will take insect food when it is available. But seeds can be easily stored while insect food cannot. This is a matter of first importance to a group whose life is spent in desert areas where the active period for most plants and insects is limited to a very short season. The seed gathering propensities of Pogonomyrmex may, therefore, be less an outcome of a special fondness for seeds than the result of a life spent under climatic conditions which severely limit the period for successful foraging.

Many of the ants of the genus Pogonomyrmex possess, on the under surface of the head, elaborate fringes of hairs which Santschi has called 'psammophores' and Wheeler 'ammochaetae'. There are two sets of such hairs, one on the inner surface of the mandibles, the other running along each side of the head. The mandibular hairs are somewhat shorter and more even in length than the gular hairs and, when the mandibles are closed, they form a sort of a grating below the mouthparts. The gular hairs are graded in length with very long ones behind and much shorter ones near the insertion of the mandibles. All the gula hairs are directed diagonally inward toward the midline of the head but it is only the long rear hairs which come anywhere near meeting at the midline. The function of these hairs is a matter which has given rise to widely different explanations. In 1907 Wheeler published a paper in which this subject was discussed. He concluded that the ammochaetae serve as cleaners for the strigils of the forelegs, which are themselves cleaning organs used to rid the antennae of dust particles. According to Wheeler the strigils of xerophiles are much more apt to become clogged with dust than those of ants which live in less arid places. This added need for cleansing the strigils would explain the frequency of ammochaetae in various desert-dwelling genera. Wheeler was able to observe that the workers of Pogo-

nomyrmex draw the strigils through the ammochaetal hairs and he interpreted this to mean that the insects were cleaning the strigils "in much the same way that we clean a comb with threads". This simile is not particularly convincing. The hairs of the strigils are very much finer than those of the ammochaetae and so closely set that there is virtually no space between them. The strigils might conceivably be cleansed by rubbing them against the ammochaetal hairs but, if so, the process would be more like drawing a fine-tooth comb along a manilla rope. In 1909 Santschi, using artificial nests, was able to observe the use of the mandibular ammochaetae in the case of *Messor barbarus*. The carrying of small quantities of dry sand was facilitated because of the support offered by the hairs below the mandibles. Santschi attempted to extend this observation to the gular ammochaetae and claimed that the much larger masses of dampened sand which the insects were able to carry were supported at the rear by the gular hairs. This statement seems very questionable, since Santschi's figures show the compacted particle of damp sand held well forward in the mandibles and, as he himself admitted, such large lumps of sand could only be carried if they were wet enough for the particles to stick together. Since his main thesis, like that of Wheeler, was intended to show why ammochaetae are characteristic of xerophiles and not of other ants, this admission is detrimental to his theory. It seems to the writer that the most reasonable explanation for the gular ammochaetae is that they offer protection to the delicate mouthparts of the ants from blowing sand. Their position would serve such a purpose admirably and this would also explain the absence of such structures in non-xerophilous genera which must excavate just as much soil and get just as dirty in the process as do the xerophiles.

The North American representatives of Pogonomyrmex have been repeatedly keyed. Mayr (1887), Wheeler (1902) and Olsen (1934) have all published keys covering this group of species. In every case these keys have used as their major split the presence or absence of spines on the epinotum. This seems such an obvious difference that it may appear ill-advised to question its value. The writer is convinced, nevertheless, that it cannot be successfully employed as a major division of the group. There are several species of Pogonomyrmex in which the epinotal armature is highly variable. Specimens coming from the same nest may have well-developed epinotal spines or a completely unarmed epinotum. It would, therefore, be necessary to have such species appear twice in the key if epinotal armature is used as a major split. This difficulty can be largely avoided by using epinotal armature in a more strategic fashion. It is often an excellent means for distinguishing between species, even

though it is unsuitable as a major key character. The following key has been constructed on the basis of the above considerations and, as a result, differs considerably from existing keys.

Key to the species of Pogonomyrmex

1. The flange-like projections at either side of the insertion of the petiole always rounded behind; lower surface of the head with a row of very long, coarse hairs at either side (Subgenus *Pogonomyrmex*) 2
   The flange-like projections at either side of the insertion of the petiole strongly angular or tooth-like; the lower surface of the head without hairs or with scattered hairs which are not arranged in two lateral rows (Subgenus *Ephebomyrmex*) 23
2. Worker caste strongly polymorphic, the major worker with a disproportionally enlarged head (southeastern states) ..... *badius*
   Worker caste not polymorphic, the size usually rather constant but when size differences occur the largest workers do not have disproportionally enlarged heads (southwestern states) 3
3. Clypeal border with a deep, semicircular impression, the bottom of which almost reaches the level of the frontal lobes ..... *sancti-hyacinthi*
   Clypeal border straight or with a broad, shallow concavity, the bottom of which lies anterior to the level of the frontal lobes 4
4. The antennal scapes in repose failing to reach the occipital border by an amount at least as great as the length of the first two funicular segments together 5
   The antennal scapes in repose failing to reach the occipital border by an amount no greater than the length of the first funicular joint 12
5. Epinotum always armed with two erect, well-developed spines 6
   Epinotum without spines, usually rounded but in some cases with dentiform angles present ..... *apache*
6. Occipital margin, seen from above, covered with rugae throughout 7
   Occipital margin, seen from above, with the striae and rugae largely confined to the middle third, the lateral portions bearing piligerous punctures and sometimes feebly shagreened but not rugose or striate .. 10
7. Entire thorax coarsely reticulo-rugose, the cephalic rugae becoming distinctly reticulate on the occipital corners; length 5 mm. ..... *huachucanus*
   Thorax not reticulo-rugose throughout; epinotum and often the mesonotum as well with even, subparallel, transverse rugae; the rugae on the occipital corners never distinctly reticulate; length of the largest worker at least 6.5 mm. and usually more 8
8. Cephalic rugae fine and close-set with the interrugal sculpture largely absent except for a few coarse punctures 9
   Cephalic rugae coarser and more widely spaced with the interrugal sculpture consisting of rugules and granulations as well as coarse punctures *barbatus* subsp. *rugosus*
9. Color uniform, ferrugineous red ..... *barbatus*

Head and thorax blackish brown, the gaster black with the base of the first segment marked with yellow . . . . . *barbatus* subsp. *fuscatus*

10. Dorsum of the pronotum without distinct rugae or with delicate rugae which are not heavy enough to dull the shining surface 11
Dorsum of the pronotum with strong, transverse rugae which extend entirely across it and make the surface dull or feebly shining . . . . . *desertorum* subsp. *ferrugineus*

11. Epinotal spines slightly tapered from base to tip . . . . . *desertorum*
Epinotal spines not tapered, as slender at the base as at the tip . . . . . *desertorum* subsp. *tenuispina*

12. Interrugal sculpture of the head consisting of feeble punctures which do not obscure the shining surface 13
Interrugal sculpture of the head consisting of very dense, distinct punctures, the surface opaque or very feebly shining 16

13. Epinotum always armed with two erect, well-developed spines . . *subnitidus*
Epinotum without spines, usually rounded, rarely angular 14

14. Node of the petiole slender, distinctly longer than its anterior peduncle *longinodis*
Node of the petiole shorter and thicker, not longer than its anterior peduncle 15

15. Color uniform, clear yellow, the gaster scarcely or not at all darker than the head and thorax . . . . . *californicus*
Gaster in large part black, notably darker than the yellow head and thorax, petiolar nodes often brown . . . . . *californicus* subsp. *estebanius*

16. Postpetiole largely or entirely covered with transverse rugae; ventral tooth of the postpetiole well-developed . . . . . *subdentatus*
Postpetiole with the transverse rugae, when present, confined to the posterior third of the node, the remainder of the node granulose or densely punctate; ventral tooth of the postpetiole poorly developed or absent . . 17

17. Basal third of the first gastric segment opaque, densely punctate or very heavily shagreened . . . . . *salinus*
Basal third of the first gastric segment moderately to strongly shining, the surface at most very feebly shagreened 18

18. Posterior face of the node of the petiole with rough irregular rugae in addition to the dense punctures 19
Posterior face of the node of the petiole punctate or shagreened only . . 20

19. Epinotal spines shorter than, or at least no longer than, the distance which separates their bases, the spines distinctly tapered from base to tip . . . . *occidentalis* subsp. *comanche*
Epinotal spines distinctly longer than the distance which separates their bases, the spines scarcely tapered over most of their length . . . *occidentalis*

20. Epinotal spines usually well-developed, only rarely reduced to dentiform angles 21
Epinotum never armed with spines, usually rounded, rarely slightly angular 22

21. Interrugal sculpture of the thorax heavy and dense, often largely obscuring the rugae, the thoracic surface completely opaque; head and thorax

ferrugineous; length 4.5 mm. ..... *owyheei*
Interrugal sculpture of the thorax dense but not obscuring the rugae, the thoracic surface feebly shining; head and thorax yellowish red; length 7 mm. ..... *hindleyi*

22. Node of the petiole seen from behind only slightly higher than wide with a distinct nipple-like projection in the middle of the crest; surface of the thorax dull or very feebly shining; color rich, ferrugineous red .....
maricopa subsp. *barnesi*
Node of the petiole seen from behind distinctly higher than wide, the crest bluntly angular in the middle but usually without the central nipple; surface of the thorax moderately shining; color yellow or orange. . *maricopa*

23. The anterior ridge or welt which closes the antennal fossa produced into a broadly triangular tooth which projects forward at the side of the median lobe of the clypeus 24
The anterior ridge or welt which closes the antennal fossa not produced into a tooth ..... *pima*

24. Basal half of the first gastric segment sculptured and largely opaque; postpetiole heavily punctate and almost completely opaque .....
imberbiculus subsp. *townsendi*
Basal half of the first gastric segment without sculpture, the entire segment smooth and shining; postpetiole feebly punctate and moderately shining
imberbiculus

Subgenus POGONOMYRMEX Mayr

1. POGONOMYRMEX APACHE Wheeler

P. apache Wheeler, Psyche, Vol. 9, p. 329 (1902) ♀.
Type loc: Ft. Davis, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: western Texas and southern Arizona. At present there appear to be no published records from New Mexico but the insect must certainly occur in the mountain regions in the southern part of that state.

2. POGONOMYRMEX BADIUS (Latreille)

Formica badia Latreille, Fourmis, p. 238, pl. 11, figs. 71 A–D (1802) ♀ ♀.
P. badius Emery, Zool. Jahrb. Syst., Vol. 8, p. 310 (1895); Wheeler, Amer. Naturalist, Vol. 36, p. 99, fig. 8 (1902) ♀; Wheeler, Psyche, Vol. 9, p. 392 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 499, pl. 1, figs. 1, 2 (1934) ♀.
Atta badius Lepeletier, Hist. Nat. Hym., Vol. 1, p. 174 (1836).
Myrmica transversa F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 129 (1858) ♀.
Pogonomyrmex transversa Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 359 (1886); Mayr, Ibid., Vol. 37, p. 610 (1887) ♀.
Atta crudelis F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 170 (1858).

Myrmica crudelis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 760 (1862) ♀ ♀.
Pogonomyrmex crudelis Mayr, Ann. Soc. Natur. Modena, Vol. 3, p. 170 (1868); McCook, Agri. Ant., p. 311, pl. 10, 11 (1879); Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 610 (1887) ♀.
? *Myrmica brevipennis* F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 130 (1858) ♂.
? *Pogonomyrmex brevipennis* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 359 (1886); Mayr, Ibid., Vol. 37, p. 610 (1887) ♂.
Type loc: Carolina. Types: none in this country.
Range: Florida to North Carolina and west into Mississippi.

The single record of *badius* from New Jersey is a puzzling one. The presence in the pine barrens of a number of southern forms which are found with *badius* elsewhere would indicate that *badius* might occur there. If so it must be exceedingly rare. Although Dr. Wheeler collected intensively in the pine barrens he was never able to find *badius* there and this has been the experience of the writer as well. It also seems to be absent in the stretch of similar country which runs southward along the eastern shore of Virginia.

The nests of *badius* usually consist of flattened craters with an irregular central entrance. The species is unusually docile for a Pogonomyrmex but if they are aroused to the point of using their stings, the pain is more severe than that of any other species known to the writer.

3. Pogonomyrmex barbatus (F. Smith)

The treatment herein proposed for the *barbatus* complex runs counter to that accepted by most myrmecologists for the past seventy-five years. This course requires justification. It is unfortunate that a review of the situation involves so much intricate material. The complicated and lengthy discussion which follows is necessary if we are to clear away certain time-hallowed misconceptions which have obscured the true character of the *barbatus* complex.

In Olsen's 1934 monograph of the genus Pogonomyrmex the classical version of the *barbatus* complex is strictly maintained. His arrangement, identical with that given by Emery in the *Genera Insectorum,* is as follows:

P. barbatus F. Smith (1858)
var. *fuscatus* Emery (1895)
var. *marfensis* Wheeler (1902)
var. *molefaciens* Buckley (1860)
var. *nigrescens* Wheeler (1902)
subsp. *rugosus* Emery (1895)

The taxonomy of a group whose two oldest representatives share descriptive honors between Smith and Buckley may well be suspect. There can be no question that this circumstance has contributed to the present unsatisfactory state of the complex but no one familiar with subsequent developments can justly claim that either Smith or Buckley should be saddled with the full responsibility. Smith's original description of *barbatus* was based upon a female taken in Mexico. The insect was assigned to the genus Myrmica and, because of the worthless description, it remained unrecognizable for a number of years. For this reason Buckley cannot be blamed that he failed to realize that the insect which he described in 1860 as *Myrmica* (*Atta*) *molefaciens* was a synonym of *barbatus*. In 1868 Mayr set up the genus Pogonomyrmex. At that time he described several new species in the genus and transferred to it Latreille's *badius* and Smith's *barbatus*. It is by no means clear how Mayr was able to make the transfer in the case of *barbatus*, for he did not see the type in the British Museum until nearly twenty years later. About 1870 Mayr began to receive from Norton, a contemporary and friend of Buckley, considerable material coming from the western United States. A part of this material appears to have been identified by Buckley and may actually have contained cotypes of some of Buckley's species. In any case it is evident that when Mayr examined the British Museum collection in 1886 he was in position to speak with authority concerning the identity of *barbatus* and *molefaciens*. With his usual modesty Mayr attributed the synonymy to McCook. This procedure was, perhaps, more polite than wise. In 1876 McCook had written to Forel and sent him specimens which he said were identical with Buckley's *molefaciens*. In reply Forel had declared the insect to be identical with Smith's *barbatus*. McCook naturally accepted this opinion without question but, as will be subsequently shown, Forel had no clear idea of the exact nature of *barbatus* at that time and his surmise, although correct, was largely guesswork. In addition to the specimens which he had from McCook, Forel possessed others, apparently taken by Saussure in Mexico. In comparing the two lots Forel noted that the Texas specimens sent him by McCook were ferrugineous, while those coming from Mexico were notably darker in color. This color difference was observable in all the castes. Without any attempt to verify the correctness of his assumption Forel proceeded to associate the dark specimens with the typical *barbatus*, which thus became the "Mexican harvester", while the ferrugineous specimens were given varietal status under Buckley's name *molefaciens* and christened the "Texas harvester". If Forel had taken the trouble to read Smith's description of *barbatus*, he might have discovered that

the color of the insect is clearly described as ferrugineous. Mayr, of course, realized this and when, in 1887, he described the male of *barbatus*, he noted that the insect is of a clear, yellow color. In view of the fact that Mayr was the only myrmecologist who had been able to compare authentic material of *molefaciens* and *barbatus*, it is curious that so little attention was paid to his opinion. Instead, other workers in the field have elected to follow the lead of Forel and, in so doing, have involved themselves in a hopeless tangle. In 1895 Emery described two new variants in the complex. Both of these, the variety *fuscatus* and the subspecies *rugosus*, were dark forms but, since *rugosus* showed marked sculptural peculiarities, only the first form made trouble. The color characteristics of *fuscatus* appeared so similar so those of Forel's "typical *barbatus*" that Emery found it necessary to redefine the latter form. It emerged from this overhaul as an insect having a black head and thorax and red petiolar nodes and gaster. Thus Emery was able to distinguish *fuscatus* as being brownish red with the gaster brown. In 1902 Wheeler attacked the *barbatus* problem and added two more varieties. Both of these were dark but, because Wheeler accepted Emery's definition of the characteristics of the "typical *barbatus*", he was able to satisfy himself of the validity of the varieties *nigrescens* and *marfensis*. Additional consideration led Wheeler to attempt a further clarification of the nature of the "typical *barbatus*". In 1914 he noted that this insect is "distinctly smaller and perhaps a little darker than the workers of the variety *molefaciens*. . . . ". Additional differences were found in the case of the sexual forms.

From the above it is clear that the typical *barbatus* is an extraordinarily protean form or else that the principal criterion for the recognition of this form in the past has been that the specimens have been taken in Mexico. I propose to return to the position advocated by Mayr and regard the typical *barbatus* as identical with the ferrugineous variant *molefaciens*. Contrary to the supposition published by Forel in the *Biologia Centrali Americana*, the range of this insect is not primarily confined to Texas. It is by far the most abundant form in Mexico and has a southern range greatly in excess of any of the dark variants. Of the latter I regard only two as valid. The variety *fuscatus* is an upland form which has a distribution not unlike that of the typical *barbatus*. The subspecies *rugosus* is a northern variant which, apparently, does not enter Mexico. The varieties *nigrescens* and *marfensis* appear to me to be synonyms of *fuscatus*, although the former may be an intergrade between *fuscatus* and *rugosus*. There follows the synonymy of *Pogonomyrmex barbatus* F. Smith:

Myrmica barbata F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 130 (1858) ♀.
P. barbatus Mayr Ann. Soc. Natur. Modena, Vol. 3, p. 170 (1868); Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 971 (1870) ♀; McCook, Agri. Ant. (1879) ♀ ♀ ♂; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 610 (1887) ♀ ♂.
Myrmica molefaciens Buckley, Proc. Acad. Nat. Sci. Phila., p. 445 (1860) ♀; Lincecum, Proc. Acad. Nat. Sci. Phila., p. 323 (1886); McCook, Ibid., p. 299 (1877).
P. molefaciens Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 365 (1886).
P. barbatus var. *molefaciens* Forel, Ann. Soc. Ent. Belg., Vol. 30, C. R. p. 42 (1886); Emery, Zool. Jahrb. Syst., Vol. 8, p. 308 (1895) ♀ ♀ ♂; Wheeler, Amer. Naturalist, Vol. 36, p. 98 (1902); Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 497 (1934) ♀.
Type loc: Mexico. Types: none in this country.
Range: southern Kansas and Oklahoma through western Texas into Mexico and southwestward through New Mexico and Arizona. The insect also occurs sporadically in extreme southern Utah.

In the United States *barbatus* prefers nest sites in areas of comparatively low elevation. It is only in the southern part of its range that it is commonly found at elevations of more than 3000 feet.

4. Pogonomyrmex barbatus fuscatus Emery

P. barbatus var. *fuscatus* Emery, Zool. Jahrb. Syst., Vol. 8, p. 309 (1895) ♀ ♀; Wheeler, Amer. Naturalist, Vol. 36, p. 98 (1902); Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 497 (1934) ♀.
P. barbatus Wheeler, Amer. Naturalist, Vol. 36, p. 91, 98, fig. 4 (1902) ♀; Wheeler, Psyche, Vol. 9, p. 390 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 496, pl. 2, fig. 2 (1934) ♀.
P. barbatus var. *nigrescens* Wheeler, Psyche, Vol. 9, p. 389 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 479 (1934) ♀.
P. barbatus var. *marfensis* Wheeler, Amer. Naturalist, Vol. 36, p. 98 (1902) ♀; Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 497 (1934) ♀.
P. barbatus subsp. *curvispinosus* Cole, Ent. News, Vol. 47, No. 5, p. 120 (1936) ♀.
Type loc: Colorado. Types: none in this country.
Range: western Texas, New Mexico, southern Colorado and Arizona and south into Mexico.

Superficially considered the range of the subspecies *fuscatus* appears to coincide rather closely with that of the typical *barbatus*. There is, however, a marked preference for higher elevations in the case of

fuscatus which keeps the two separated. In western Texas *fuscatus* usually occurs at elevations of 4000 feet or above while the typical *barbatus* rarely reaches such an elevation within our borders. This circumstance contributes to the more discontinuous distribution of *fuscatus* which is well represented only in mountainous areas. In several parts of its range *fuscatus* comes in contact with the northern race *rugosus*. Where the two forms meet intergrades are produced. I regard Cole's *curvispinosus* and Wheeler's *marfensis* as such intergrades. Wheeler's *nigrescens* appears to be a straight synonym of *fuscatus*.

5. Pogonomyrmex barbatus rugosus Emery

P. barbatus subsp. *rugosus* Emery, Zool. Jahrb. Syst., Vol. 8, p. 309 (1895) ♀ ♂; Wheeler, Amer. Naturalist, Vol. 36, p. 98 (1902) ♀; Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 497 (1934) ♀.

P similis Olsen, Ibid., p. 512, pl. 6, fig. 2 (1934) ♀.

Type loc: San Jacinto, California. Types: none in this country.

Range: northwestern Texas, northern New Mexico, southwestern Colorado, southern Utah, Arizona and California.

Olsen records *rugosus* only from Arizona and California but this is certainly incorrect. While the insect is rather sporadic in Texas it is fairly abundant in northern New Mexico and southern Utah. It appears to enter Colorado only in the extreme southwestern part of the state.

The species described by Olsen as *similis* is a synonym of *rugosus*. The types of *similis* have a very striking, dull surface, quite unlike that of *rugosus*. An examination of these types convinced the writer that this peculiar dull appearance is due to encrusted soil particles. A thorough cleaning of one type specimen proved the correctness of this supposition. *P. similis* is nothing but a small and very dirty worker of *rugosus*.

The nests of *rugosus* are usually built in stony soil in open deserts. They consist of a gravel disc without any superstructure. There is usually a considerable cleared area around the disc.

6. Pogonomyrmex californicus (Buckley)

In the opinion of the writer the constitution of the species *californicus* has been highly unsatisfactory. Much of this difficulty seems attributable to the fact that the exact nature of the typical *californicus* is

conjectural. For many years, however, it has been agreed that the insect that Buckley described as *californicus* is a comparatively small species (about 6 mm.) with a completely unarmed epinotum, a feeble sculpture and a uniform yellow coloration. This being the case there would seem to have been very little reason for assigning to *californicus* some of the forms that have been treated as subspecies or varieties of it. There is, for example, little to justify Forel's association of *hindleyi* with *californicus*. It is true that the epinotal armature of *hindleyi* is variable but in those specimens where spines are not present the epinotum is marked by dentiform angles. The sculpture of *hindleyi* is notably heavier than that of *californicus*. Indeed, about the only thing that Forel seems to have been able to find to relate the two species is a similarity in the shape of the head. To accord separate specific status to *hindleyi* is no particular problem. The burden rests with those who are seeking reasons for the retention of this insect as a variant of *californicus*. Similar considerations apply in the case of *maricopa* and its western subspecies *barnesi*. This species is notably larger and stockier than *californicus*, with a characteristic dense cephalic sculpture, distinctly bulkier petiolar nodes and a stronger impression at the mesoepinotal suture. These differences are considerably more pronounced than those which separate certain species having epinotal spines and it is hard to avoid the impression that the principal reason for making *maricopa* a subspecies of *californicus* has been its lack of epinotal spines. In the opinion of the writer *maricopa* should certainly have specific rank and it has been treated as a species in the present volume.

The status of the two remaining forms of *californicus* which occur in the United States is much more difficult to evaluate. The variety *estebanius* and the subspecies *longinodis* both present problems which seem insoluble on the basis of our present knowledge. There is considerable reason why *estebanius* might be regarded as nothing more than a color variety of *californicus*. In 1914 Wheeler accorded subspecific rank to this form but the observations which he cited at that time are singularly confusing. Thus Wheeler claims that *estebanius* 'averages a little smaller in all three phases than the typical *californicus*'. Yet the measurements which he presented for the male and female of *estebanius* are larger than those which he gave for the typical *californicus*. I cannot see that there is any significant difference in the size of the two forms, nor can I see that the differences which Wheeler described in the structure of the node of the petiole are sufficiently constant to give good separation. On the other hand, the two forms are readily separable on the basis of color and in this instance the color difference appears to be correlated with distribution.

It is possible, therefore, to treat *estebanius* as a geographical race of *californicus* although, for reasons which have been explained on a subsequent page, the matter needs additional verification in the field.

The situation concerning *longinodis* is exceedingly puzzling. When Emery described *longinodis* in 1895 he had specimens which will have to be regarded as authentic material of the typical *californicus*. It was Emery who finally realized the nature of Buckley's species. Previously Mayr had considered it a synonym of *badius*. In 1895 Emery also had type specimens, or at least authentic specimens, of Pergande's *estebanius*. This has enabled us to be certain of the sculptural characteristics of the insect which Emery treated as the typical *californicus*. Since he found only a color difference between *californicus* and *estebanius*, it is clear that Emery's typical *californicus* was the concolorous, lightly sculptured insect that has since been accepted as the exemplar of Buckley's species. But while there has been good agreement on the typical *californicus* there has been no such agreement in the case of *longinodis*. Emery's original description of *longinodis* cited a number of differences which separate this insect from the typical *californicus*. The petiolar joints are slenderer, with the postpetiole longer than high and the petiole with a node which is pointed above and longer than its anterior peduncle. The sculpture is feebler with both the striae (or rugae) and the sculpture between them much weaker. The petiolar nodes are punctate but lack striae. It is significant that Emery regarded these differences as great enough to warrant subspecific status for *longinodis*. In 1902 Wheeler used several of Emery's distinctions almost verbatim in his keys. The same is true of the key in Olsen's 1934 monograph. I have no fault to find with such usage but I would like to point out that the specimens identified as *longinodis* by Wheeler will not check with the key characters given for that subspecies. It is true that in these specimens the node of the petiole is much longer than that of *californicus* but the node is not distinctly pointed above and, despite its length, it is not longer than the anterior peduncle, for that part is also greatly elongated. The cephalic sculpture is notably heavier than that of the typical *californicus*. It may be noted that all of the specimens identified as *longinodis* by Wheeler come from stations in New Mexico and Texas. The type locality of *longinodis* is the 'Colorado Desert' in California.

It is the opinion of the writer that the true *longinodis* has been taken only once and that Emery's types may be the only material of this insect at present in a collection. At least I have never seen any specimens that agree with Emery's description and there seem to be no published records that anyone has since taken this insect in California. This leads to a very awkward situation as regards the eastern

specimens which have previously been treated as *longinodis*. Until we know more about *longinodis* it seems impossible to be certain as to whether the specimens coming from New Mexico and Texas are an eastern race of *longinodis* or a separate species. There is, of course, the possibility that they are actually the same as Emery's *longinodis* but this seems very unlikely. I find it impossible to believe that such a meticulously careful worker as Emery could have made the descriptive errors which such a contention would imply. It seems to me that the best course at present is to attempt no formal recognition of these specimens until their relationship to *longinodis* is more clearly understood. At the same time, I believe that it is necessary to raise *longinodis* to specific rank. The eastern specimens and the typical *californicus* occur in the same stations without intergradation and it is safe to assume that the same situation occurs in California. It is impossible to consider *longinodis* as a subspecies of *californicus* under such circumstances. There follows the synonymy of *P. californicus* Buckley:

Myrmica californica Buckley, Proc. Ent. Soc. Phila., p. 336 (1868) ♀.

P. californicus Emery, Zool. Jahrb. Syst., Vol. 8, p. 311(1895); Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀; Wheeler, Ibid., Vol. 21, p. 153 (1914) ♀ ♀ ♂; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 499, pl. 2, fig. 3 (1934) ♀.

P. badius Mayr, Ann. Soc. Nat. Modena, Vol. 3, p. 170 (1868); Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 971 (1870) ♀; Mayr, Ibid., Vol. 37, p. 610 (1887) ♀ (*nec* Latreille).

Type loc: California. Types: none known to exist.

Range: southern California to western Texas and south into Mexico. The range of *californicus* apparently does not extend north of the New Mexico-Colorado border but there is one interesting record of the insect from St. George in extreme southern Utah.

7. Pogonomyrmex californicus estebanius Pergande

P. badius subsp. *estebanius* Pergande, Proc. Cal. Acad. Sci. (2), Vol. 4, p. 33 (1893) ♀.

P. californicus var. *estebanius* Emery, Zool. Jahrb. Syst., Vol. 8, p. 311 (1895); Wheeler, Amer. Natural, Vol. 36, p. 98 (1902); Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀.

P. californicus subsp. *estebanius* Wheeler, Psyche, Vol. 21, p. 154 (1914) ♀ ♀ ♂; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 499 (1934).

Type loc: Calmalli Mines, San Estaban, Lower California. Types: U.S.N.M.

Range: deserts of southern Arizona, southern California and Lower California.

The geographical relationship of *estebanius* is a peculiar one which at present cannot be explained in an altogether satisfactory way. In the much more extensive range of the typical *californicus* there are areas on the east, the north and the west where pure stands of the insect occur. This is not the case with *estebanius*, except in the Imperial Desert of California. In southern Arizona *estebanius* and *californicus* are both present and this seems true also of the western portion of the Mojave Desert. It would be much more in keeping with the concept of *estebanius* as a geographical race if it showed a more distinctive range of its own. Unless I am very much mistaken, this range lies in northwestern Mexico. A better knowledge of the distribution of *estebanius* in the provinces of Sonora and Chihuahua should show a southern extension of *estebanius* alone, comparable to the northern range of the typical *californicus*. For the occurrence of *estebanius* in many parts of the Imperial Desert, an area which is not utilized by *californicus*, seems to indicate that it is much more thermophilous than *californicus*.

8. Pogonomyrmex desertorum Wheeler

P. desertorum Wheeler, Psyche, Vol. 9, p. 387 (1902) ♀ ; Emery in Wytsman Genera Insectorum, Fasc. 174, pl. 1, fig. 8 (1921) ♀ ; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 496, pl. 3, fig. 2 (1934) ♀ .

Type loc: Presidio County, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: western Texas and southeastern New Mexico.

9. Pogonomyrmex desertorum ferrugineus Olsen

P. desertorum var. *ferrugineus* Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 506 (1934) ♀ .

Type loc: Tucson, Arizona. Types: M.C.Z., A.M.N.H.

Range: southern Arizona to southern New Mexico.

In the opinion of the writer, the principal difference which distinguishes *ferrugineus* from the typical *desertorum* is the heavy, transverse, pronotal sculpture of the former insect. In the typical *desertorum* the dorsum of the pronotum is often very feebly sculptured and the rugae, if present, are longitudinal except on the neck of the pronotum, where they may be transverse. In *ferrugineus* the entire pronotum is covered with coarse, transverse rugae. The color differences and the distinctions based upon spine length which Olsen cited seem to be too variable to be of much separatory value. It seems clear that *ferrugineus*

should be considered as a geographical race for it intergrades with the typical form in southwestern New Mexico.

10. Pogonomyrmex desertorum tenuispina Forel

P. desertorum var. *tenuispina* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 50, p. 269 (1914) ♀.
Type loc: uncertain, probably Lower California. Types: none in this country.
Range: apparently confined to Lower California.

In describing this insect Forel noted that the types had been received from Pergande in the United States ("Reçu des États Unis de M. Pergande"). It has, therefore, been customary to regard *tenuispina* as occurring within our borders. But so far all specimens referable to this subspecies have come from Lower California and it is probable that the insect does not occur in the United States.

11. Pogonomyrmex hindleyi Forel

P. californicus var. *hindleyi* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 50, p. 270 (1914) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 499 (1934) ♀.
Type loc: Escondido, California. Types: none in this country.
Range: California, Arizona and New Mexico.

It is to be regretted that no type specimens of *hindleyi* are present in American collections. It will be necessary to examine the types of this insect before we can be certain of its exact status. Even without this, however, it is reasonably certain that Forel was in error when he assigned *hindleyi* to *californicus*. This matter has been discussed in the introduction to *californicus*. At the present time it seems best to treat *hindleyi* as a separate species. It is certainly not related to *californicus* on the basis of structure, nor will its distribution allow it to be considered as a geographical race of that species. It should be borne in mind, however, that when *hindleyi* is better known it may prove to be a race of some other species. In the opinion of the writer it is rather closely related to *subdentatus* and it is interesting to note that both forms show the same variability in epinotal armature. The epinotum may bear only small triangular denticles or fully developed spines as long as those of *occidentalis*. These extremes and intermediate conditions connecting them are normally found within most nest series.

12. Pogonomyrmex huachucanus Wheeler

P. huachucanus Wheeler, Psyche, Vol. 21, p. 151 (1914) ♀ ; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 497, pl. 4, fig. 1 (1934) ♀.
Type loc: Miller Canyon, Huachuca Mts., Arizona. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: various mountain ranges in southern Arizona.

13. Pogonomyrmex longinodis Emery

P. californicus subsp. *longinodis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 311 (1895) ♀ ; Wheeler, Amer. Naturalist, Vol. 36, p. 99 (1902); Wheeler, Psyche, Vol. 19, p. 392 (1902) ♀ ; Wheeler, Ibid., Vol. 21, p. 155 (1914); Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 499 (1934) ♀.
Type loc: Colorado Desert, California. Types: none in this country.
Range: California to western Texas.

As I have shown in the introduction to *californicus*, the taxonomy of *longinodis* is at present in a very unsatisfactory state, with considerable differences present in the material which has been assigned to this species. The key carried in this volume has been designed to take care of specimens showing the characteristics which Emery cited for *longinodis*. The specimens of *longinodis* coming from western Texas and New Mexico would key down to *maricopa*, from which they would differ in the longer and much more slender petiolar node and its thin, elongate, anterior peduncle. The petiole of these specimens is about one and a half times as long as that of *maricopa*.

The nest of *longinodis* is seldom surmounted by a cone. The excavated material is usually scattered about with little attempt to form a superstructure above the nest. In this respect the insect differs from *californicus* and *maricopa* both of which heap the excavated material above the nest.

14. Pogonomyrmex maricopa Wheeler

P. californicus subsp. *maricopa* Wheeler, Psyche, Vol. 21, p. 155 (1914) ♀ ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 500 (1934) ♀.
Type loc: Alamogordo, New Mexico. Types: M.C.Z., A.M.N.H.
Range: deserts of southeastern California to western Texas. The insect appears to be more abundant in southern Arizona than in any other part of the range.

Anyone who has compared the distribution of *maricopa* and *californicus* will appreciate the fact that the ranges of the two insects in the United States coincide with remarkable exactness. It is true that

californicus occurs in the coastal area of California, where *maricopa* is not present, but this seems to be the only significant difference. From the Mojave Desert of California to El Paso, Texas the two occur in the same stations with no difference of elevation which might separate them. This being true, it is quite impossible to contend that *maricopa* is a subspecies of *californicus* on distributional grounds alone. It may be admitted that the two insects are closely related but it would seem that there is quite enough structural difference in the two to justify specific status for *maricopa*. In point of fact the two may be separated at a glance for the deeper color and notably larger and bulkier stature of *maricopa* gives it an appearance quite unlike that of *californicus*. However, there are a number of other differences. The cephalic sculpture of the two insects is totally unlike. That of *maricopa* is heavy and dense with the surface completely opaque. The thoracic sculpture of *maricopa* is also heavier than that of *californicus*, although there appears to be more variation in this latter characteristic. In addition, the epinotum of *maricopa* is more angular than that of *californicus* with the mesoepinotal suture usually more distinctly impressed. The petiole and postpetiole of *maricopa* are notably more bulky than those of *californicus*. The differences listed above will apply equally well to *maricopa* subsp. *barnesi*.

15. Pogonomyrmex maricopa barnesi M. R. Smith

P. californicus subsp. *barnesi* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 22, p. 546 (1929) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 499 (1934) ♀.

Type loc: 20 miles northwest of Phoenix, Arizona. Types: Coll. M. R. Smith, M.C.Z.

Range: central Arizona west to the Imperial and Mojave Deserts.

Although the range of *barnesi* appears to be lapped by the much more extensive range of the typical *maricopa*, it seems to occur at lower elevations than does the typical form. I have seen intergrades between *barnesi* and *maricopa* which were taken at Needles, California by Dr. A. C. Cole.

16. Pogonomyrmex occidentalis (Cresson)

Myrmica occidentalis Cresson, Proc. Ent. Soc. Phila., Vol. 4, p. 426 (1856) ♀ ♀.

P. occidentalis Cresson, Trans. Amer. Ent. Soc., Vol. 7, p. 22 (1879); McCook, Honey Ants and Occident Ants, p. 123–162, fig. 107–112 (1882) ♀ ♀ ♂; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 610 (1887); Emery, Zool.

Jahrb. Syst., Vol. 8, p. 310 (1895); Wheeler, Amer. Naturalist, Vol. 36, p. 92, 98, fig. 5 (1902) ♀; Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 498, pl. 4, fig. 2 (1934) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 544, pl. 5, fig. 20 (1947) ♀.

Myrmica seminigra Cresson, Proc. Ent. Soc. Phila., Vol. 4, p. 427 (1865) ♂.

P. opaciceps Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 971 (1871) ♀.

P. occidentalis subsp. *ruthveni* Gaige, Proc. Bio. Soc. Washington, Vol. 27, p. 93 (1914) ♀ ♀ ♂.

Type loc: Colorado. Types: A.N.S.P.

Range: southern North Dakota to central Oklahoma and west to Nevada, the deserts of eastern Oregon and arid areas in eastern Washington and southern British Columbia.

Although the area outlined above embraces the main range of *occidentalis*, there are scattered records from stations outside it. Thus *occidentalis* has been reported from western Iowa and Missouri. I believe, however, that it may be doubted that *occidentalis* has been able to establish itself in either state. A line drawn from eastern South Dakota to central Oklahoma would rather closely approximate the eastern limit of the range of *occidentalis*. It has been my experience that the eastern boundary of the range of *occidentalis* is an unusually abrupt one. I have repeatedly observed that the insect is extremely rare in eastern Kansas but about twenty or thirty miles west of Salina one suddenly comes upon areas where the colonies are fully as abundant as they are anywhere in the range. The southern end of the range of *occidentalis* is rather irregular, due to the preference of this species for nest sites at increasing elevation in southern stations. Thus through New Mexico and Arizona the range of *occidentalis* follows elevated table lands or low mountain ranges. Since it has been taken in the mountains of southern Arizona, there is every reason to suppose that *occidentalis* occurs in the highlands of Sonora, although at present there seem to be no Mexican records for the insect.

The conspicuous, conical mound nests made by *occidentalis* are a characteristic part of many western landscapes. The mounds are usually about two feet across at the base and perhaps a foot high. The openings are at the base of the mound. There is usually a large, circular, cleared disc surrounding the mound.

17. Pogonomyrmex occidentalis comanche Wheeler

P. occidentalis subsp. *comanche* Wheeler, Psyche, Vol. 9, p. 392 (1902) ♀.

P. comanche Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 498 (1934) ♀ *nec.* pl. 3, fig. 1; *nec.* Wheeler, Psyche, Vol. 21, p. 156 (1914) ♀ ♂.

P. occidentalis subsp. *utahensis* Olsen, Ibid., p. 509 (1934) ♀ ♀ ♂.

Type loc: Milano, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton. Range: western Texas to Arizona.

There have been so many errors made in regard to the taxonomy of *comanche* that it is hard to know where to begin their rectification. One may as well start with the curious error which occurs in Olsen's monograph. The thorax of *comanche* bears short but very distinct epinotal spines. In the figure which Olsen presented as *comanche* the thorax is shown as spineless. Whatever Olsen's figure of *comanche* may be, it is certainly not *comanche*. A much more serious difficulty has arisen from Wheeler's attempt to associate females and males with the worker of *comanche*. Unless I am very much mistaken, this association was incorrect and it has been the cause of much subsequent misunderstanding. As may be recalled, Wheeler originally described the worker of *comanche* as a subspecies of *occidentalis* in 1902. Twelve years later he raised the insect to specific rank on the basis of differences in the epinotal armature of the male and female and the mandibular structure of the male. The insect which Wheeler regarded as the male of *comanche* had narrow mandibles with a transverse masticatory margin bearing three or four teeth. There are some extraordinary observations in Wheeler's 1914 discussion of *comanche*. For example Wheeler states:

"In the worker *comanche* the thoracic dorsum is distinctly more rounded and arched in profile than in the worker *occidentalis*, and the epinotal spines are *longer* (italics mine, W.S.C.) both in the worker and female but especially in the latter."

The distinction which Wheeler originally used to separate *comanche* from *occidentalis* was the fact that *comanche* has much shorter epinotal spines. This fact can be verified by an examination of the worker types. It cannot be supposed that this peculiar inconsistency is due to Wheeler having written longer when he meant shorter for he also noted that the male of *comanche* has longer epinotal teeth than that of *occidentalis*. We thus have the unusual situation of a worker with short epinotal spines associated with sexual forms in which the epinotal spines or teeth are unusually long. The matter becomes even more incomprehensible when it is considered that in the worker of *occidentalis* the spines are much longer than those of *comanche* and yet the sexual forms of *occidentalis* have much shorter epinotal spines than those of the males and females which Wheeler assigned to *comanche*.

In my opinion the sexual forms which Wheeler assigned to *comanche* cannot possibly belong to that form. I base this opinion on the characteristics of the sexual forms of the insect which Dr. Olsen described as *occidentalis* subsp. *utahensis*. The type material of *utahensis* was taken by the writer in Zion National Park in 1932. The males

of this insect have a tuberculate epinotum without teeth. Their mandibles have an oblique masticatory margin with five to six teeth. They thus agree with the *occidentalis* male and not at all with the insect which Wheeler regarded as the male of *comanche*. Dr. Olsen was, therefore, correct in relating them to *occidentalis* rather than to Wheeler's male of *comanche*. Unfortunately the worker of *utahensis* cannot, in my opinion, be separated from that of *comanche*. Olsen attempted to separate the two on the basis of an excised clypeus in *occidentalis* and a straight one in *comanche*. I am sorry to say that this difference is of no value. The amount of incision of the clypeus varies in both forms. In a series of four cotypes of *comanche* which I have before me, one has an almost straight clypeal edge, two have a moderately incised clypeal edge and the fourth specimen has a clypeal incision fully as deep as any found in *occidentalis*. I have made every effort to discover some difference by which the worker of *utahensis* can be separated from that of *comanche* but I have been unable to find one.

But if, as I believe, *comanche* and *utahensis* are the same, it will be necessary to revaluate the status of *comanche*. The differences which separate this insect from *occidentalis* are its shorter epinotal spines and very slightly more convex thorax. It would, therefore, seem that Wheeler was right when he treated *comanche* as a subspecies of *occidentalis* in 1902. The range of *comanche* runs from western Texas to Arizona. Since there are not more than a half a dozen published records for this insect, it is impossible to get a very satisfactory picture of its distributional characteristics. But it would seem that the records for *comanche* come from lower elevations than do those of *occidentalis*. In general the latter form occurs at elevations of 5000 feet or more in the southern part of its range. For this reason in southern New Mexico and Arizona *occidentalis* is usually confined to mountain valleys or high plateaus. From the little we know of *comanche* the insect prefers low plains or canyon bottoms where *occidentalis* rarely occurs. Hence there is no reason why *comanche* may not be regarded as a southern, low-level subspecies of *occidentalis*. As Wheeler has pointed out the nests of *comanche* are usually not surmounted by conical mounds but by a low and rather irregular crater.

18. Pogonomyrmex owyheei Cole

P. occidentalis subsp. *owyheei* Cole, Amer. Mid. Naturalist, Vol. 19, No. 1, p. 240 (1938) ♀ ♀.

Type loc: Indian Cove, Hammet, Idaho. Types: Coll. A. C. Cole, Coll. W. S. Creighton.

Range: known only from type material.

At first sight the small size of this curious little species seems to ally it to *huachucanus*. Actually, however, the two insects have little in common. The scapes of *owyheei* are notably longer than those of *huachucanus* and the thoracic sculpture of the two insects is entirely different. Dr. Cole treated *owyheei* as a subspecies of *occidentalis* and its structure certainly relates it to the group of species to which *occidentalis* belongs. In 1942 Dr. Ernst Mayr showed that the distribution of *owyheei* is such that it can scarcely be a subspecies of *occidentalis* and it may be added that it shows enough structural difference from *occidentalis* to warrant specific status on the latter basis as well. According to Cole, *owyheei* makes small crater nests in pure sand.

19. Pogonomyrmex salinus Olsen

P. salinus Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 510, pl. 5, fig. 3 (1934) ♀.
Type loc: Soda Springs, Bridgeport, California. Types: M.C.Z.
Range: known only from the type material.

20. Pogonomyrmex sancti-hyacinthi Wheeler

P. sancti-hyacinthi Wheeler, Psyche, Vol. 9, p. 388 (1902) ♀.
Type loc: San Pedro Springs, San Antonio, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: low mountains in western Texas and eastern New Mexico.

The clypeal incision of *sancti-hyacinthi* is quite different from that of any other North American species. In the species where the clypeus is incised, the incision is usually broad and shallow. In *sancti-hyacinthi* it is rather narrow and very deep. In some specimens it extends behind the tips of the frontal lobes. This species seems to be rather sporadic and rare. I have made strenuous efforts to take it in some of the same stations where Wheeler secured his specimens but I have never seen this insect in the field.

21. Pogonomyrmex subdentatus Mayr

P. subdentatus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 971 (1870) ♀; Mayr, Ibid., Vol. 37, p. 610 (1887); Wheeler, Amer. Naturalist, Vol. 36, p. 94, fig. 6 (1902) ♀; Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 497, pl. 5, fig. 2 (1934) ♀.
Type loc: California. Types: none in this country.
Range: known from California only.

The area of greatest abundance for *subdentatus* seems to be the region just south of San Francisco, where it occurs in the dry valleys of the Coast Range. There are records of *subdentatus* coming from stations as far south as San Diego but it is by no means as abundant in the southern part of the state as is *subnitidus*.

22. Pogonomyrmex subnitidus Emery

P. occidentalis var. *subnitidus* Emery, Zool. Jahrb. Syst., Vol. 8, p. 310 (1895) ♀; Wheeler, Amer. Naturalist, Vol. 36, p. 98 (1902); Wheeler, Psyche, Vol. 9, p. 391 (1902) ♀.

P. subnitidus Wheeler, Psyche, Vol. 21, p. 156 (1914); Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 498, pl. 4, fig. 3 (1934) ♀.

Type loc: San Diego County, California. Types: none in this country.
Range: coastal region of southern California north to the Mojave Desert.

Subgenus Ephebomyrmex Wheeler

23. Pogonomyrmex (Ephebomyrmex) imberbiculus Wheeler

P. imberbiculus Wheeler, Amer. Naturalist, Vol. 36, p. 86, fig. 1, 2 (1902) ♀.

P. (*Ephebomyrmex*) *imberbiculus* Wheeler, Psyche, Vol. 9, p. 390 (1902) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 495, pl. 6, fig. 3 (1934) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 544, pl. 5, fig. 21 (1947) ♀.

Type loc: Mt. Barker, Austin, Texas. Types: A.M.N.H., M.C.Z.
Range: western Texas and southern New Mexico.

This species is our only representative of the subgenus *Ephebomyrmex* which is at all abundant. It appears to be fairly widespread in western Texas, where it occurs on upland plateaus. The colonies are comparatively small and the rather obscure nests are often built under stones.

24. Pogonomyrmex (Ephebomyrmex) imberbiculus townsendi Wheeler

P. (*E.*) *townsendi* Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 80 (1909) ♀; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 495, pl. 8, fig. 2 (1934) ♀.

Type loc: Ojo del Cerro Chilicote, Chihuahua, Mexico. Type: M.C.Z.
Range: deserts of southern Arizona south into Mexico.

Although both Wheeler and Olsen treated *townsendi* as a separate species, I believe that it should be considered as a southern race of *imberbiculus*. It is very rare within our borders and the few specimens which have been taken have come from stations close to the Mexican boundary. The main range of this subspecies undoubtedly lies in Mexico.

25. Pogonomyrmex (Ephebomyrmex) pima Wheeler

P. (E.) pima Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 79 (1909) ♀ ; Olsen, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 8, p. 495, pl. 7, fig. 1 (1934) ♀ .
Type loc: Tucson and Phoenix, Arizona. Types: M.C.Z., A.M.N.H.
Range: desert areas in central and southern Arizona.

Genus Stenamma Westwood

(Plate 17, figures 1–4)

The taxonomic difficulties which surround the North American representatives of Stenamma are out of all proportion to the small number of forms involved. There are at present nine described forms which occur in the United States and Canada. Although Emery, Forel and Wheeler have each made revisionary proposals for this group, the existing arrangement is far from satisfactory. In order that the treatment followed in the present work may be fully understood, I have prefaced it with an account of the previous revisionary proposals. Unless these are considered, it is unlikely that an accurate idea of the relationships within the group can be secured.

When Mayr first described *nearcticum* and *brevicorne* in 1886, the only other known species was the European *westwoodi*. Mayr was able to show that the wing venation of *nearcticum* is identical with that of *westwoodi*, i.e., the inner branch of the cubital vein arises from the cross-vein. The venation of *brevicorne* differed in that the inner branch of the cubital vein arises from the middle of the cubital cell. Mayr had associated workers with his winged specimens of *nearcticum* but, in the following year, he restricted the description to the sexual castes. Although more than a half century has passed, and although much study has been devoted to the matter, the worker of *nearcticum* still remains unknown. This has been one of the major stumbling blocks in the taxonomy of our forms. When Emery dealt with the North American representatives of Stenamma in 1895, he used the venational similarity of *nearcticum* and *westwoodi* to make *nearcticum* a subspecies of the latter insect. In addition he recognized the subspecies *diecki*

and the variety *impressum*, both of which he assigned to *westwoodi*. This still left *brevicorne* recognizable only because of its wing venation.

In 1901 Forel took a hand in the matter. I wish to examine his conclusions with some care for it seems to me that most of the ills which beset our representatives of Stenamma can be attributed directly to them. I have, therefore, presented below Wheeler's translation of Forel's statement.

'This subgenus (*Stenamma*) presents an almost inextricable tangle of allied forms. The sculpture of the American species is denser than that of *S. westwoodi* of Europe. I believe that they should be separated specifically if only for the sake of unravelling the tangle. On the other hand I doubt whether *S. diecki* Emery, really belongs to *nearcticum* and believe that it belongs rather to *brevicorne*. Emery gives the differential characters between the American workers and the typical *westwoodi* but not between the workers of *nearcticum* and *brevicorne*. Now the fundamental difference between these two species lies in the wings, and none of the specimens described by Emery as *nearcticum*, *diecki*, etc., seem to have possessed these appendages, as the author makes no mention of them. It seems to me more prudent, therefore, since the winged sexes are so little known, to retain the name *nearcticum* only for the female and male described by Mayr and to consider all other American forms as races or varieties of *brevicorne* until we have proof to the contrary.'

There can be no doubt as to what contrary proof Forel had in mind. If the winged castes of *diecki*, *impressum* and *impar* should have proven to have the venation of *nearcticum*, Forel would have been wrong in assigning these insects to *brevicorne*. But the fallacy which neither Forel nor Wheeler appreciated is the assumption that if these insects have a wing venation like that of *brevicorne* they must be considered infraspecific variants of that species as a result. There is no logical basis for such a belief, yet it has formed the cornerstone on which our treatment of these forms has rested. This has been due in large part to Wheeler's 1903 revision of this group. Wheeler not only accepted Forel's stand without reservation but gave it additional prominence by stating that he had been able 'to establish the truth of Professor Forel's conjecture.' Wheeler had received a cotype of *diecki* from Emery and one of *impar* from Forel. With these he was able to make the necessary association with the winged castes which showed that *diecki* and, presumably *impar* also, had the wing venation of *brevicorne*. As a result Wheeler treated these forms, and others which he subsequently described, as variants of *brevicorne*. The only North American representatives of Stenamma which have managed to escape the all-embracing clutch of *brevicorne* are *nearcticum* and the insect which M. R. Smith described in 1930 as *fovolocephalum*.

It should be patent to anyone who has worked out the distribution of the various forms which have been assigned to *brevicorne* that the arrangement cannot possibly be defended on a distributional basis. The group shows a welter of coincidental ranges that would discourage any attempt to treat most of the variants as geographical races. In the northeastern United States there are three forms, *schmitti, impressum* and *impar,* which often occur in the same stations and whose nests are not infrequently in close proximity. The little known variants *heathi* and *sequoiarum* occur on the west coast, hence their ranges are widely separated from those of the three eastern forms just mentioned. But the range of *diecki* includes both the eastern and western forms, and in addition the situation is complicated by the occurrence of the typical *brevicorne,* whose range covers the northeastern United States and extends as far west as Wisconsin. Despite these overlapping ranges the variants manage to maintain their distinctive characteristics rather well, a circumstance that would be unthinkable if they were geographical races. They are behaving as species, not as subspecies, and if any satisfactory treatment for the group is to be made, this fact will have to be recognized. Of this group of forms only *sequoiarum* can, in my opinion, be considered as a geographical race. The rest must be treated as species and in most cases their structural distinations are good enough to justify this view. That this fact has not been recognized sooner is undoubtedly attributable to the undue influence which Forel's views have exerted on the taxonomy of this group.

The habits of our species are little known. They form small colonies of a few dozen workers. The nests are usually situated in wooded areas and may be built in leaf mould, under stones or logs or beneath thick, loose moss. The ants are timid, sluggish and rarely seen outside the nest. Because of this fact it was Wheeler's opinion (1903) that they are subterranean or nocturnal in habit. Wheeler also believed that they feed on small larvae and other animal food. There is, however, no published data to indicate the correctness of these surmises. The insects seem to offer considerable possibilities for those interested in habit studies.

The following key is an expansion and modification of that published by Wheeler in 1903:

Key to the species of Stenamma

1. Inner branch of the cubital vein arising from a cross-vein (worker unknown) *nearcticum*

   Inner branch of the cubital vein arising from the middle of the cubital cell (the remainder of the key deals with the worker caste).....2

2. Dorsum of the thorax, petiole and postpetiole with irregular, rugose, reticulate sculpture 3
   Dorsum of the thorax, petiole and postpetiole showing at least some longitudinal rugae near the middle, those at the sides curved but scarcely reticulate 4
3. Eyes with 6–7 facets in greatest diameter ..... *fovolocephalum*
   Eyes with no more than four facets in greatest diameter ..... *heathi*
4. Entire head, thorax and nodes of the petiole opaque, the interrugal spaces roughened and dull 5
   Rear of head, thorax and nodes of the petiole feebly to strongly shining, the interrugal spaces smooth 7
5. Length, 2.5–4 mm.; color dark brown to black ..... *brevicorne*
   Length 2.4–3 mm.; color brown or red 6
6. Eyes with at least six facets in greatest diameter; epinotal spines well developed ..... *impar*
   Eyes with only three or four facets in greatest diameter; epinotal spines small ..... *schmitti*
7. Mesoepinotal depression moderate; epinotal spines robust and only slightly directed upward; color reddish brown 8
   Mesoepinotal depression broad and deep; epinotal spines short and distinctly directed upward; color dark brown ..... *impressum*
8. Rugae at the base of the gaster rather feeble and indistinct ..... *diecki*
   Rugae at the base of the gaster pronounced and prominent
   diecki subsp. *sequoiarum*

1. Stenamma brevicorne (Mayr)

Aphaenogaster brevicorne Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 447 (1886) ♀ ♀.

S. brevicorne Emery, Zool. Jahrb. Syst., Vol. 8, p. 298 (1895) ♀ ♀ ♂; Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 347 (1901); Wheeler, Psyche, Vol. 10, p. 166 (1903) ♀.

S. nearcticum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 454 (1886) ♀ (not ♀ or ♂); Mayr, Ibidem, Vol. 37, p. 628 (1887).

Type loc: Virginia. Types: none in this country.

Range: northeastern United States and southern Ontario south to Virginia and west to Wisconsin. The record from Friday Harbor, Washington reported by Wheeler in 1903 appears to have been an error. It may be doubted that *brevicorne* occurs in the far west.

2. Stenamma diecki Emery

S. westwoodi subsp. *diecki* Emery, Zool. Jahrb. Syst., Vol. 8, p. 300 (1895) ♀ ♀.

S. brevicorne subsp. *diecki* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 347 (1901); Wheeler, Psyche, Vol. 10, p. 167 (1903) ♀.

Type loc: Yale, British Columbia. Types: M.C.Z.

Range: northeastern United States, southern Canada west to the Pacific coast.

3. Stenamma diecki subsp. sequoiarum Wheeler

S. brevicorne subsp. *sequoiarum* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 520 (1917).
Type loc: Muir Woods, Mt. Tamalpais, California. Types: M.C.Z., A.M.N.H.
Range: known from type material only.

This form is so little known that it is impossible to be certain of its exact status. There would seem to be no reason, however, why it should not be provisionally regarded as a subspecies of *diecki*.

4. Stenamma fovolocephalum M. R. Smith

S. fovolocephalum M. R. Smith, Ann. Ent. Soc. Amer., Vol. 23, p. 564 (1930) ♀.
S. foveolocephalum M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 554, pl. 6, fig. 22 (1947) ♀.
Type loc: Ackerman, Mississippi. Types: Coll. M. R. Smith; Coll. Dept. Ent. A & M Coll. Miss.
Range: known only from type material.

5. Stenamma heathi Wheeler

S. brevicorne subsp. *heathi* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 410 (1915) ♀.
Type loc: Kings River Canyon, California. Types: M.C.Z., A.M.N.H.
Range: known only from type material.

6. Stenamma impar Forel

S. brevicorne subsp. *impar* Forel, Ann.Soc.Ent.Belg., Vol. 45, p. 347 (1901) ♀ ♀.
Type loc: worker, Potomac River, Virginia: female, Franklin Park, Boston, Mass. Types: A.M.N.H.
Range: Atlantic Coast States, Massachusetts to Virginia.

The single specimen marked as a type in the collection of the A.M.N.H. bears the locality label 'Washington, D. C.' It may or may not be a part of the type series but in any case it was collected and identified by Forel.

7. Stenamma impressum Emery

S. westwoodi subsp. *diecki* var. *impressum* Emery, Zool. Jahrb. Syst., Vol. 8, p. 301 (1895) ♀ ♀.
S. brevicorne subsp. *diecki* var. *impressum* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 347 (1901); Wheeler, Psyche, Vol. 10, p. 167 (1903) ♀.

Type loc: Richs Spring, New York. Types: none in this country.
Range: southern New York south down the Appalachian Highlands to Tennessee. Cole reports that in the southern part of the range the insect occurs only at elevations above 5000 feet.

8. Stenamma nearcticum Mayr

S. neoarcticum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 454 (1886) ♀ ♂ (not ♀); Mayr, Ibidem, Vol. 37, p. 628 (1887); Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 347 (1901); Wheeler, Psyche, Vol. 10, p. 166 (1903).
S. westwoodi subsp. *nearcticum* Emery, Zool. Jahrb. Syst., Vol. 8, p. 299 (1895) ♀.
Type loc: California (by present restriction). Types: none in this country.
Range: Pacific Coast States and British Columbia.

It would seem necessary to restrict the type locality of *nearcticum* to California, since the insect does not occur in the eastern states. It may be that Mayr's specimens from Virginia and New Hampshire were those which he subsequently discarded as not belonging to *nearcticum*.

9. Stenamma schmitti Wheeler

S. brevicorne subsp. *schmitti* Wheeler, Psyche, Vol. 10, p. 167 (1903) ♀.
Type loc: St. Vincent, Pennsylvania. Types: A.M.N.H., M.C.Z.
Range: at present recorded only from Pennsylvania and Ohio. The insect probably occurs in several of the central Atlantic States as well.

Genus Aphaenogaster Mayr

Subgenus Attomyrma Emery

(Plate 18, figures 1–4)

Under the plan which Emery proposed in the *Genera Insectorum*, all representatives of Aphaenogaster coming from America north of Mexico were placed in the subgenus Attomyrma. Although this plan has been followed in the present volume, it should be understood that Emery's arrangement is by no means conclusive. The definitive criterion which distinguishes Attomyrma from the subgenus Deromyrma is a difference in wing venation. The other criteria which Emery used are less satisfactory. It is not practical to attempt to separate the two subgenera by using the shape of the head in the

worker caste. A number of our species, which Emery included in Attomyrma, have workers in which the head is produced into a 'neck' in all respects similar to that which is supposed to distinguish the worker of Deromyrma. Several of these long-headed species are known only from the worker caste. Until the sexual phases can be associated with such workers, it is impossible to be certain whether they belong to Attomyrma or to Deromyrma. A similar consideration applies to some of the species which Emery assigned to Deromyrma. A final solution of this difficulty will depend upon a much better knowledge of the sexual phases than we possess at present. In the meantime it seems preferable to employ Emery's arrangement.

The nesting habits of our species of Aphaenogaster vary widely. The majority of the species nest in the soil and usually start the nest beneath some covering object. If this happens to be a log, the ants may construct a part of the nest in it but the main part of the nest is usually subterranean. The nests of *lamellidens* and *tennesseensis*, on the other hand, are usually constructed in rotten stumps and fallen logs with few of the passages running into the soil. This preference for nests in rotting wood takes a rather unusual turn in the case of *mariae*. The writer has never been able to find *mariae* in the field but Dr. L. G. Wesson, who has taken it on several occasions, tells me that the insect always nests in dead branches at a considerable height above the ground. To judge from the rather scanty data at present available *miamiana* is also arboreal. I have received specimens of this insect taken from hollow pecan twigs.

The nest-founding activities of two of our species of Aphaenogaster are in need of investigation. It has been generally assumed that *mariae* and *tennesseensis* are temporary social parasites on *fulva* or *rudis*. The first two species both possess small females and that of *tennesseensis* is further distinguished by its very smooth and shining surface. This characteristic is all the more striking because the worker of *tennesseensis* has a rough and heavy surface sculpture. It seems entirely probable that the structural peculiarities shown by the female of *tennesseensis* are connected with a parasitic type of nest founding but nothing definite is known in this regard. Indirect evidence is offered by the fact that a few mixed colonies of *tennesseensis* and *fulva* have been reported.

Our species of Aphaenogaster are by no means uniform in their degree of differentiation. This has led to confusion in the case of closely related species, several of which have been regarded as subspecies. Further confusion has resulted from the incorrect assumption that certain species are strictly monomorphic. Varietal names have been proposed for the smaller workers and even for minims from

incipient nests. It should be obvious that size distinctions of this sort are of no significance unless accompanied by comparable differences in the sexual castes. Finally, a number of our species are prone to considerable variation in color. By selecting certain nest series it is possible to secure color varieties which are strikingly distinct. Yet it is only rarely that such color differences have a geographical significance and when they do, the color is usually correlated with a structural difference. The above considerations have led me to treat many of the described variants with a heavy hand. Although a large number of varieties have gone into the synonymy, there is consolation in the fact that those which remain can be handled without splitting nest series or violating zoögeographical precepts.

Key to the species of Attomyrma

1. Antennal scape with a conspicuous lobe which extends rearward along the basal fourth or fifth of the scape 2
   Antennal scape without a basal lobe or, if a small lobe is present, it projects forward and does not involve the basal fifth of the scape 4
2. Lobe of the scape, seen from the side, flat and thin, its length usually not more than one-fifth the length of the scape . . . . . *ashmeadi*
   Lobe of the scape, seen from the side, thick, its upper face forming an obtusely projecting angle in the middle, its length usually one-fourth the length of the scape or longer 3
3. Head (mandibles excluded) one-fourth longer than broad, the sides not narrowed immediately behind the eyes, the occiput broadly and evenly rounded; longitudinal rugae usually extending onto the occiput . . . *treatae*
   Head (mandibles excluded) one-third longer than broad, the sides beginning to narrow immediately behind the eyes, the occiput narrow and flat in the middle; posterior third of the head granulose but only rarely with longitudinal rugae . . . . . *treatae* subsp. *pluteicornis*
4. Basal quarter of the first gastric segment with delicate striae which spread fan-wise from the attachment of the postpetiole . . . . . *mariae*
   Gaster without basal striae, or if striae are present they do not spread fan-wise and are limited to the basal eighth of the segment 5
5. Outer face of the frontal lobe bearing a flange which projects rearward in the form of a tooth . . . . . *lamellidens*
   Outer face of the frontal lobe without a toothed flange 6
6. Postpetiole broader than long and suboval in shape; epinotal spines longer than the basal face of the epinotum . . . . . *tennesseensis*
   Postpetiole as long as broad or longer than broad, globular or like a truncated cone in shape; epinotal spines, when present, shorter than the basal face of the epinotum 7
7. Antennal scapes of the larger workers (not always true of the minims) surpassing the occipital margin by an amount less than the length of the

first two funicular joints 8
Antennal scapes of all workers surpassing the occipital margin by an amount greater than the length of the first two funicular joints 12
8. Mesopleurae heavily sculptured and opaque 10
Mesopleurae at least in part smooth and shining 9
9. Cephalic rugae delicate but clearly visible; color piceous brown.. *patruelis*
Cephalic rugae very feeble, often hard to see without oblique illumination; color yellow ..... *patruelis* subsp. *bakeri*
10. Head with abundant, fine, punctato-rugose sculpture between the longitudinal rugae; color castaneous brown to piceous brown 11
Head with very feeble interrugal sculpture; head and thorax orange yellow, gaster deep brown ..... *uinta*
11. Largest workers 6 mm. in length, female 8 mm. in length; color usually castaneous brown ..... *subterranea* subsp. *valida*
Largest workers 4.5 mm. in length, female 6.5 mm. in length; color usually piceous brown ..... *subterranea* subsp. *occidentalis*
12. Epinotum unarmed, rounded or angular but without distinct teeth or spines 13
Epinotum armed with distinct teeth or spines 15
13. Clypeus distinctly carinate; head widest at the level of the eyes and about equally narrowed behind and in front of them ..... *mutica*
Clypeal carina indistinct; the head much more narrowed behind the eyes than in front of them 14
14. Base of the antennal scape with a small lobe which projects anteriorly; node of the petiole longitudinally oval when seen from above and scarcely wider than its posterior peduncle ..... *floridana*
Base of the antennal scape without a lobe; node of the petiole almost circular when seen from above and distinctly wider than its posterior peduncle ..... *boulderensis*
15. Middle of the pronotum with very feeble sculpture, its surface strongly shining; epinotal spines very slender ..... *flemingi*
Entire pronotum heavily shagreened or densely sculptured, its surface opaque or subopaque; epinotal spines not notably slender 16
16. Base of the antennal scape with a small, angular lobe which projects forward 17
Base of the antennal scape without such a lobe 18
17. Epinotal spines only a little shorter than the basal face of the epinotum *macrospina*
Epinotum armed with short, triangular teeth ..... *huachucana*
18. Anterior edge of the mesonotum rising abruptly above the adjacent portion of the pronotum, the transverse welt thus formed distinctly concave in the middle; epinotal spines at least as long as the declivious face of the epinotum and strongly directed upwards ..... *fulva*
Mesonotum not abruptly elevated above the pronotum or, if it is higher, the anterior edge does not form a transverse welt; epinotal spines rarely as long as the declivious face of the epinotum and usually directed backward 19

19. Head of the largest workers (mandibles excluded) not more than one-sixth longer than broad; head of the smaller workers approximately one-fifth longer than broad 21
Head of the worker, regardless of size, approximately one-third longer than broad 20
20. Large workers 5.5 mm. in length; female 7 mm. in length ..... *texana*
Large workers 4.5 mm. in length; female 5.5 mm. in length ..... *texana* subsp. *carolinensis*
21. Eyes with 13–15 facets in greatest diameter; epinotal spines slightly incurved when seen from above; basal face of the epinotum with very coarse, transverse rugules ..... *miamiana*
Eyes with 10–11 facets in greatest diameter; epinotal spines divergent when seen from above; transverse rugae on the basal face of the epinotum feeble and often replaced by punctures 22
22. The area between the eye and the frontal lobe with reticulate rugae which are not obscured by the interrugal sculpture; pronotum often crossed with transverse rugules ..... *rudis*
The area between the eye and the frontal lobe densely punctate with the punctures largely obscuring or replacing the rugae; pronotum evenly punctato-granulose, without transverse rugules ..... *rudis* subsp. *picea*

1. Aphaenogaster (Attomyrma) ashmeadi Emery

A. treatae var. Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 444 (1886) ♀.
A. treatae subsp. *ashmeadi* Emery, Zool. Jahrb. Syst., Vol. 8, p. 302 (1895) ♀.
A. (*Attomyrma*) *treatae* subsp. *harnedi* Wheeler, Psyche, Vol. 26, p. 50 (1919) ♀.
Type loc: Florida. Types: none in this country.
Range: eastern Gulf Coast states.

The only difference which separates *harnedi* from *ashmeadi* is the lighter color of the former insect. Structurally the two are identical. The distinction which Wheeler attempted to make in the case of gastric punctuation will not hold. In any substantial series of workers from a single nest both sorts of punctuation are present. Wheeler appears to have been misled on this point because he lacked adequate material of *ashmeadi* at the time when *harnedi* was described.

2. Aphaenogaster (Attomyrma) boulderensis M. R. Smith

A. (*Attomyrma*) *boulderensis* M. R. Smith, Great Basin Naturalist, Vol. 2, No. 3, p. 120 (1941) ♀.
Type loc: Horseshoe Island, Mead Lake, Boulder Dam, Arizona.
Type: U.S.N.M. Paratypes: U.S.N.M., Coll. V. M. Tanner, Coll. W. S. Creighton.
Range: known only from type material?

There appears to have been considerable confusion in regard to *boulderensis* prior to its recognition as a separate species by Dr. Smith in 1941. Both Wheeler and I had confused *boulderensis* with Pergande's *mutica,* a species from which it is clearly distinct. Through the courtesy of Dr. M. R. Smith I have recently been able to examine the types of both *boulderensis* and *mutica.* This examination settled one question but raised another. I now feel considerable doubt that *mutica* occurs in the United States and believe that previous records attributed to that species probably should go to *boulderensis.* Because of the uncertainty in regard to these records I have made no attempt to determine the range of *boulderensis* but it will not be surprising if subsequent investigation shows the insect occurring as far east as trans-Pecos Texas.

3. Aphaenogaster (Attomyrma) flemingi M. R. Smith

A. texana subsp. *flemingi* M. R. Smith, Ent. News, Vol. 39, p. 275 (1928) ♀.
Type loc: A & M College, Mississippi. Types: Coll. M. R. Smith, M.C.Z., Coll. Dept. Ent. Miss. A & M College, Coll. W. S. Creighton.
Range: known only from type material.

The slender epinotal spines and feeble thoracic sculpture of *flemingi* readily distinguish this insect from *texana.* It must be considered as a separate species for *texana* occurs so widely in the southeastern United States that there is no possibility that *flemingi* can have a range separate from that of *texana.*

4. Aphaenogaster (Attomyrma) floridana M. R. Smith

A. (Attomyrma) floridana M. R. Smith, Great Basin Naturalist, Vol. 2, No. 3, p. 118 (1941) ♀.
Type loc: Gretna, Florida. Type and Paratypes: U.S.N.M.
Range: known from Florida only.

A. floridana appears to be rather closely related to *huachucana* for both species have elongate heads and in each the scape bears a small angular lobe at the base. The two species are, however, quite clearly distinct. The size of *floridana* is notably smaller (4.5–5 mm.), it is much more lightly sculptured and the epinotum is, at most, angular and lacks the distinct teeth which are present in *huachucana.*

5. Aphaenogaster (Attomyrma) fulva Roger

A. fulva Roger, Berl. Ent. Zeitschr., Vol. 7, p. 190 (1863) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 445 (1886) ♀ ♀ ♂.

Stenamma fulvum Emery, Zool. Jahrb. Syst., Vol. 8, p. 303 (1895) ♀ ♀ ♂.
A. fulva var. *rubida* Enzmann, Jour. N. Y. Ent. Soc., Vol. 55, pl. 8 (1947) ♀.
Type loc: 'North America'. Types: none in this country.
Range: northeastern United States to northern Alabama and west to Ohio.

In the present work a number of forms, previously regarded as varieties of *fulva*, have been treated as representatives of a separate species, *rudis*. For a discussion of this matter see the introduction to *rudis*.

6. Aphaenogaster (Attomyrma) huachucana Creighton

A. (*Attomyrma*) *huachucana* Creighton, Psyche, Vol. 41, p. 189 (1934) ♀.
Type loc: Ramsey Canyon, Huachuca Mts. (7000′) Arizona.
Cotypes: Coll. W. S. Creighton, M.C.Z., A.M.N.H., U.S.N.M., Coll. A. C. Cole.
Range: known only from type material.

7. Aphaenogaster (Attomyrma) lamellidens Mayr

A. lamellidens Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 444 (1886) ♀ ♀ ♂.
Stenamma lamellidens Emery, Zool. Jahrb. Syst., Vol. 8, p. 302 (1895).
A. (*Attomyrma*) *lamellidens* var. *nigripes* M. R. Smith, Ent. News, Vol. 34, p. 308 (1923) ♀.
Type loc: Virginia (by present restriction). Types: none in this country.
Range: areas of low or moderate elevation throughout the entire southeastern United States from southern Delaware to Florida and west to the Mississippi Valley.

I have recently discussed with Dr. Smith the circumstances under which the variety *nigripes* was described and have presented them here because of their instructive character. When Dr. Smith first encountered the specimens which were later to be called *nigripes*, he sent some of them to Dr. Wheeler for specific identification. In reply Dr. Wheeler stated that he regarded the insect as a new variety of *lamellidens* which differed from the typical form because of its black legs. In 1923 *lamellidens* was represented in Dr. Wheeler's collection by a few old and badly faded specimens whose color had lost all resemblance to the lively color of fresh material. These specimens, highly atypical as far as color is concerned, became the 'typical *lamellidens*' to which *nigripes* was contrasted. This difficulty would probably never have arisen if Wheeler had possessed a field acquaintance with *lamellidens*. The writer has taken *lamellidens* in a large number of stations extending from southern Delaware to the Gulf of Mexico. I have never seen a colony in the field which did not have the charac-

teristics of *nigripes*. I have never seen any fresh specimens which showed the color that Wheeler considered characteristic of his 'typical *lamellidens*'. For these reasons I propose to regard *nigripes* as identical with *lamellidens* and to treat Wheeler's color distinction as a matter of no taxonomic significance.

8. Aphaenogaster (Attomyrma) macrospina M. R. Smith

A. texana subsp. *macrospina* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 27, No. 3, p. 386, figs. 1, 2 (1934) ♀.
Type loc: Charleston, South Carolina. Types: Coll. M. R. Smith, U.S.N.M.
Range: South Carolina to Florida.

In my opinion *macrospina* should be regarded as a separate species rather than as a subspecies of *texana*. From a geographical standpoint the range of *macrospina* is largely blanketed by that of *texana*, which removes the possibility of treating *macrospina* as a geographical race. There is little difficulty in according specific status to *macrospina* for the insect shows a number of structural differences which separate it from *texana*. In *macrospina* the eyes occur closer to the middle of the side of the head (a little in front of the middle in *texana*). The posterior half of the head in *macrospina* is less narrowed than that of *texana*, with the occipital margin distinctly wider and the occipital angles more broadly rounded. The scape of *macrospina* has a small, basal, angular lobe which is lacking in *texana*. The epinotal spines of *macrospina* are far longer and heavier than those of *texana*. The sculpture of *macrospina* is less heavy than that of *texana*, particularly on the posterior part of the head and the pronotum, which are smooth and shining in *macrospina*.

9. Aphaenogaster (Attomyrma) mariae Forel

A. mariae Forel, Ann. Soc. Ent. Belg., Vol. 30, C. R. p. 41 (1886) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 443 (1886) ♀.
Stenamma mariae Emery, Zool. Jahrb. Syst., Vol. 8, p. 301 (1895).
Type loc: Florida. Types: none in this country.
Range: apparently very discontinuous; scattered records from Florida, Mississippi, Ohio and Illinois.

10. Aphaenogaster (Attomyrma) miamiana Wheeler

A. (*Attomyrma*) *texana* var. *miamiana* Wheeler, Jour. N. Y. Ent. Soc., Vol. 40, p. 5 (1932) ♀ ♀ ♂.
Type loc: Miami, Florida. Types: M.C.Z., A.M.N.H.
Range: Florida, southern Alabama and Mississippi.

The color of *miamiana* varies considerably. Its large eyes, heavy sculpture and incurved epinotal spines permit an easy separation from *rudis*, to which it seems rather closely related. This species was imported into the New York area at some period prior to 1908 but has, apparently, died out since.

11. Aphaenogaster (Attomyrma) mutica Pergande

A. mutica Pergande, Proc. Calif. Acad. Sci. (2), Vol. 5, p. 891 (1895) ♀.
Type loc: San Jose del Cabo, Mexico. Types: U.S.N.M.
Range: Lower California.

Wheeler has recorded *mutica* from the Brownsville region of Texas but there is reason to doubt that *mutica* occurs within our borders (see discussion under *boulderensis*). If so, one would expect to find it along the southern border of California rather than in Texas. This species appears to be rather closely related to *patruelis* and, when we have a better knowledge of the ant fauna of Lower California, it may prove to be a southern race of *patruelis*.

12. Aphaenogaster (Attomyrma) patruelis Forel

A. patruelis Forel, Ann. Soc. Ent. Belg., Vol. 30, C. R. p. 41 (1886) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 270 (1904).
Stenamma subterranea subsp. *patruelis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 302 (1895).
A. (*Attomyrma*) *patruelis* subsp. *willowsi* Wheeler, Proc. Calif. Acad. Sci., Vol. 21, No. 6, p. 64 (1933) ♀.
Type loc: Guadeloupe Island, Lower California. Types: none in this country.
Range: (in the United States) coastal islands of California.

In my opinion there is no doubt that the subspecies *willowsi*, which Wheeler described from a single worker specimen, is a synonym of *patruelis*. According to Wheeler, *willowsi* 'differs from the typical *patruelis* only in the less convex base of the epinotum, less developed sculpture and paler coloration.' Through the kindness of Dr. Cockerell the writer has had for study an excellent series of specimens from St. Nicholas Island, the type locality of *willowsi*. The variation within the series is such that it would include both the typical *patruelis* and *willowsi*. For this reason *willowsi* has been treated as a synonym of *patruelis*.

13. Aphaenogaster (Attomyrma) patruelis bakeri Wheeler

A. patruelis subsp. *bakeri* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 270 (1904) ♀.

Type loc: Catalina Island, California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: known only from type material.

14. Aphaenogaster (Attomyrma) rudis Emery

In the present work *rudis* and its subspecies *picea* have been separated from *fulva* and treated as representatives of a separate species. This treatment is necessary for two reasons. In the first place, there is a marked and constant difference in the thoracic structure of the two species which involves not only the length of the epinotal spines but also the over all proportions of the thorax, especially the mesonotum (see key). Added to this is the fact that, since *fulva* occurs in the same stations as *rudis* or *picea*, the last two forms cannot properly be regarded as subspecies of *fulva*. In addition to the change proposed above I have abandoned Buckley's name *aquia*, since it seems impossible to determine to what form it applies. Since all of these proposals run counter to the arrangement which has been accepted for the last half a century, I wish to review certain difficulties which have beset this group of forms from the start.

Three years after Roger presented the original description of *fulva* Buckley described an insect which he called *Myrmica aquia*. The description is so poor that it offers no clue even as to the genus. That anyone could have ascertained the species from the description alone is unthinkable. It may be assumed, therefore, that when Mayr made *aquia* a synonym of *fulva* in 1886, he did so on the basis of specimens sent him by Norton. It is much to be regretted that *aquia* could not have been allowed to remain as a synonym of *fulva*. In 1895, however, Emery began working with the rather heterogeneous assemblage of material that had accumulated under *fulva* and proposed to draw taxonomic distinctions based in large part on the length of the epinotal spines. Emery recognized that Roger's *fulva* is distinguished by long epinotal spines, hence he felt justified in giving subspecific status to those variants with short epinotal spines. This made it necessary to resuscitate Buckley's *aquia*, for the description of *aquia* states that the epinotal spines are small. Since Emery recognized more than one short-spined variant, it became necessary for him to select one of these as representing Buckley's *aquia*. This choice appears to have been purely arbitrary and a matter about which Emery was none too happy,

for he stated that Pergande agreed with him that *aquia* should be assigned to *fulva*, a curious point to raise in the case of a form which had existed as a synonym of *fulva* for the previous nine years. There is, however, one important consideration to be borne in mind. In 1895 Emery presented simultaneously the descriptions of *aquia*, *rudis* and *picca*. It is clear, therefore, that he felt that he was dealing with three distinct forms. Subsequent workers have found little difficulty in distinguishing between *aquia* and *picca* but *rudis* has remained something of an enigma. The reason for this became clear to the writer after examining specimens identified as *rudis* by Emery. Emery's *rudis* is the insect to which Wheeler and most of the workers on this side of the Atlantic have given the name *aquia*. This insect is slightly larger, lighter in color and more heavily sculptured than *picea*. If this is the case, what then is Emery's redescribed *aquia*? I believe that Emery's *aquia* is an intergrade between *rudis* and *picea*. In the eastern United States the range of *rudis* is separated from that of *picca* by an elevational difference, the latter form occurring at higher altitudes through the Appalachian Highlands, while *rudis* occurs in the piedmont areas at their base. There is thus the opportunity for intergradation over a rather extensive area and intergrades may be found from southern New England to North Carolina. This fact was clearly apparent to Emery, who, at the end of his redescription of *aquia*, commented on the intergrading character of this form. With the above facts in mind, it seems to the writer that it is time to stop fumbling with *aquia* and rid the nomenclature of this chronic ill. We do not know what Buckley's *aquia* was. Emery's *aquia* appears to have been an intergrade which should never have been named. I propose, therefore, to place *aquia* in the list of unrecognizable forms. There follows the synonymy of *A.* (*Attomyrma*) *rudis* Emery:

A. fulva var. *rudis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 305 (1895) ♀ ♀ ♂.
Type loc: Virginia (by present restriction). Types: none in this country.
Range: southern New England west to Wyoming and south through the piedmont to Alabama.

15. Aphaenogaster (Attomyrma) rudis picea Emery

A. fulva var. *picea* Emery, Zool. Jahrb. Syst., Vol. 8, p. 305 (1895) ♀ ♀ ♂.
Type loc: Connecticut (by present restriction). Types: none in this country.
Range: Nova Scotia south through New England and down the Appalachian Highlands to North Carolina.

16. Aphaenogaster (Attomyrma) subterranea occidentalis Emery

There are several questions connected with the New World forms of *subterranea* which are in need of clarification. The first of these concerns the status of the subspecies to which Emery gave the name *occidentalis*. Emery was of the opinion that this subspecies is very closely related to *subterranea* but he cited slight differences (longer head, slenderer scapes, etc.) which he felt entitled *occidentalis* to subspecific rank. When he made these observations Emery had only two nest series for study, the type specimens from Pullman, Washington and other specimens from Utah. In these two series of workers Emery noted variations which partially negated the distinctions on which he based *occidentalis*. The antennal scapes of the Utah specimens were thicker than those of the Pullman types. The Utah specimens, therefore, approached the typical *subterranea* very closely. If any long series of material belonging to *occidentalis* is examined, Emery's criteria appear very shaky. I am inclined to believe that *occidentalis* cannot be separated from the European form and I have allowed it to stand in the present volume only because I have been unable to examine an adequate amount of material belonging to the typical *subterranea*. When this can be done it seems virtually certain that the name *occidentalis* will have to go into the synonymy of *subterranea*.

After the description of *occidentalis* in 1895 nothing more was done with this insect until 1915. In that year Wheeler described two additional variants, the subspecies *borealis* and *valida*. Two years later he added the variety *manni*, which was based on specimens taken in the type locality of *occidentalis*. The descriptions of all three of these variants are very confusing, since they embody contradictions in the definitive characters of the three forms. Particularly is this true of sculpture and color. The minor sculptural differences cited by Wheeler are wholly without significance because of the notable variations which occur within any ordinary nest series. It seems certain that Wheeler was unaware that the smaller workers of these insects are usually more heavily sculptured than the large ones. It is obviously impossible to draw any fine sculptural distinctions under such circumstances. Much the same objection may be raised to the slight color differences which Wheeler cited; there is usually too much variation within a nest series to permit their certain application. In the course of this study the writer has examined the types of all of Wheeler's forms. Using these in conjunction with a very large number of specimens coming from more than fifty localities, I have reached the conclusion that in the New World *subterranea* is represented by only two forms. The first

is the insect which Emery called *occidentalis*. The second is Wheeler's subspecies *valida*. Distributional studies of these two insects show that they are western and eastern races. The range of *occidentalis* lies largely in the mountains of the Pacific coast states. It begins in central California and runs northward through Oregon and Washington into southern British Columbia. An eastern extension of this range carries the insect into the mountains of eastern Nevada. The subspecies *valida* is found in the Rocky Mountain region from central Colorado north through Wyoming and western Montana into southern British Columbia. The western boundary of the range of *valida* lies in the mountains of Utah. While it approaches the eastern end of the range of *occidentalis* in this region, there is little evidence that the two subspecies intergrade there. The area of intergradation is in the northern part of the range of each subspecies. It includes southern British Columbia, eastern Washington, northern Idaho and western Montana. In this region the variability of these insects is greatly increased. It is significant that three of the four described variants have come from this region. The differences which separate *occidentalis* and *valida* have been given in the key but it may be well to add that such differences can only be used with certainty when there is a considerable series of specimens available for examination. It is usually quite impossible to decide whether isolated workers belong to *occidentalis* or *valida*. There follows the synonymy of *A.* (*Attomyrma*) *subterranea occidentalis* Emery:

A. subterranea subsp. *occidentalis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 301 (1895) ♀.

A. subterranea subsp. *borealis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 412 (1915) ♀.

A. subterranea subsp. *valida* var. *manni* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 516 (1917) ♀.

Type loc: Pullman City, Washington. Types: none in this country.

Range: mountains of California from the latitude of Sequoia National Park north to British Columbia and eastward through the mountains of Nevada.

The nesting habits of *occidentalis* appear to be considerably more flexible than those of *valida*. It often founds its colonies in areas of moderately heavy cover, although it prefers open and rather dry nest sites.

17. Aphaenogaster (Attomyrma) subterranea valida Wheeler

A. subterranea subsp. *valida* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 414 (1915) ♀.

Type loc: Cheyenne Canyon, Colorado Springs. Types: A.M.N.H., M.C.Z. Specimens in the collection of the M.C.Z. bearing cotype labels and coming from Arrowhead, British Columbia are not a part of the type series.
Range: Rocky Mountain Region from central Colorado north to British Columbia and west to the mountains of Utah.

The subspecies *valida* lives by preference in the Transition Zone. Its nests are usually found in dry and fully exposed situations. As Wheeler has noted, the colonies of *valida* are more populous than those of *occidentalis*.

18. Aphaenogaster (Attomyrma) tennesseensis (Mayr)

Atta tennesseensis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 95 (1862) ♀.
Aphaenogaster tennesseensis Mayr, Ibid., Vol. 36, p. 443 (1886) ♀.
Stenamma tennesseensis Emery, Zool. Jahrb. Syst., Vol. 8, p. 301 (1895).
Stenamma tennesseensis var. *ecalcarata* Emery, Ibid., Vol. 8, p. 301 (1895) ♀.
Atta laevis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 743 (1862) ♀.
Myrmica subrubra Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 336 (1867) ♀ ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 365 (1886).
Type loc: Tennessee. Types: none in this country.
Range: New England south to the eastern Gulf States and west to Wisconsin, Missouri and eastern Oklahoma.

Emery distinguished the variety *ecalcarata* on the rather unusual basis that it possessed shorter and thicker spurs on the hind tibiae with the hairs on these parts more even. There would seem to be no reason to recognize this form. It certainly is not a northern race and the distinctions are so slight that it may be wondered why Emery chose to name it.

19. Aphaenogaster (Attomyrma) texana Emery

The fact that Emery originally assigned *texana* to *fulva* has undoubtedly caused confusion in the case of this species. But this will not account for all the difficulties which have beset the taxonomy of this insect. After it was recognized that the head of *texana* is narrow, both in the worker and female, this fact was used as the basis for assigning to *texana* variants described from minims only. Since the minims of other species may also show this trait and since nearly all minims fail to show the definitive characters of their respective species, this practice is thoroughly deplorable. The naming of the forms *nana* Wheeler, *punctithorax* Cole and *pusilla* Emery has been wasted effort. Since the type series of all three forms consisted only of minims, it

will be impossible to determine what they actually represent. I propose, therefore, to discard the above three forms as impossible of exact recognition.

There remain the variants *carolinensis, furvescens* and *silvestrii,* the last having been described by Menozzi as a separate species[1]. If one had to deal only with the type material of these variants, it would be easy to believe that they represent three geographical races of the typical *texana.* For *carolinensis* comes from North Carolina, *silvestrii* from Florida and *furvescens* from Arizona. But when additional material is examined, this view will not hold. Because of the rather spotty character of the distribution of *texana,* it is difficult to evaluate the status of some of the variants but enough material has now been accumulated to show that the color variety *furvescens* cannot be regarded as a geographical race. Dark colored individuals are known to occur over the entire range of *texana.* Conversely, light colored specimens may be found in the western portions of the range, where *furvescens* should replace them if it were a valid subspecies. The variant *silvestrii* is known from so little material that its relationship to *texana* is doubtful. Wheeler regarded this form as a synonym of *furvescens* and it certainly cannot be defended as a separate species. Yet, since the typical *texana* occurs in the same stations, it is equally hard to consider it as a valid subspecies. In this work both *furvescens* and *silvestrii* have been synonymized with the typical *texana.*

The one remaining variant, *carolinensis,* shows certain characteristics which indicate that it is a true geographical race. This variant occurs as far north as southwestern Virginia. Its range appears to follow the Piedmont and lower Appalachian levels as far south as northern Alabama. The typical *texana,* whose northern range barely enters North Carolina, is usually found in the coastal plain area. This elevational difference is not great enough to bring about a complete separation of the two forms, hence there is some intergradation in the southern Atlantic and eastern Gulf states. On the other hand, there are several areas in the Piedmont where there are "pure stands" of *carolinensis.* In this respect it differs from any other described variant and for this reason it has been retained as a valid subspecies. There follows the synonymy of *A.* (*Attomyrma*) *texana* Emery:

A. fulva var. *texana* Emery, Zool. Jahrb. Syst., Vol. 8, p. 306 (1895) ♀.
A. texana Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 412 (1915) ♀ ♀ ♂.
A. texana var. *furvescens* Wheeler, Ibid., Vol. 34, p. 413 (1915) ♀.

[1] In the same year that Menozzi described *silvestrii* (1929), Wheeler published a paper carrying the description of an Aphaenogaster from Funkiko, Formosa bearing the same name. As Menozzi's name has a priority of three months, I suggest the name *funkikoensis* for Wheeler's homonym.

A. (*Deromyrma*) *silvestrii* Menozzi, Bull. Lab. Zool. Portici, Vol. 22, p. 282, fig. 1 (1929) ♀ ♀.

Type loc: Texas. Types: none in this country.

Range: Arizona through Texas to the eastern Gulf and south Atlantic states. There appear to be no records of *texana* from New Mexico, although the insect must certainly occur there.

20. Aphaenogaster (Attomyrma) texana carolinensis Wheeler

A. texana subsp. *carolinensis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 414 (1915).

Type loc: Tryon, North Carolina. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: Piedmont region from southwestern Virginia to northern Alabama.

21. Aphaenogaster (Attomyrma) treatae Forel

A. treatae Forel, Ann. Soc. Ent. Belg., Vol. 30, C. R. p. 40 (1886) ♀ ♀ ♂; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 443 (1886).

Stenamma treatae Emery, Zool. Jahrb. Syst., Vol. 8, p. 302 (1895) ♀.

A. (*Attomyrma*) *treatae* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 554, pl. 6, fig. 23 (1947) ♀.

A. treatae subsp. *wheeleri* Mann, Psyche, Vol. 22, p. 51, fig. 16 (1915) ♀ ♀.

A. (*Attomyrma*) *treatae* var. *alabamensis* G. C. & E. W. Wheeler, Psyche, Vol. 41, No. 1, p. 11 (1934) ♀ ♀.

Range: southern New England to Florida and the eastern Gulf states. In the north central states the main range apparently terminates in Ohio. The records from areas further west are decidedly sporadic although the insect has been taken as far west as Illinois.

I have synonymized Mann's subspecies *wheeleri* with *treatae* since it seems impossible to regard this variant as a geographical race. In the original description of *wheeleri*, Mann presented an imposing list of differences which supposedly mark that insect. After an examination of the types of *wheeleri* and also of a large amount of material taken on Naushon Island, the type locality of *wheeleri*, it appears that most of these differences are not sufficiently constant to permit a satisfactory separation. Certainly they have no particular geographical significance for it is possible to find specimens referable to *wheeleri* over most of the range of *treatae*. A different situation obtains in the case of the variety *alabamensis*. The types of this insect were taken by the writer at Ft. Payne, in northern Alabama. In sculpture and in the shape of the antennal lobe the insect is clearly intermediate be-

tween the typical *treatae* and *pluteicornis*. Indeed, this was noted at the time of its original description. Since the type locality of *alabamensis* lies in a region where the range of *treatae* might be expected to meet that of its western race, *pluteicornis*, there is no reason why *alabamensis* should not be regarded as an intergrade between *treatae* and *pluteicornis*. It is rather unfortunate that it should have been given a varietal name.

22. Aphaenogaster (Attomyrma) treatae pluteicornis

G. C. and E. W. Wheeler

A. (*Attomyrma*) *treatae* subsp. *pluteicornis* G. C. & E. W. Wheeler, Psyche, Vol. 41, No. 1, p. 7, figs. 1 a, b (1934) ♀ ♀ ♂.

A. (*Attomyrma*) *treatae* subsp. *pluteicornis* var. *oklahomensis* G. C. & E. W. Wheeler, Ibid., Vol. 41, p. 10, fig. 1 c, d (1934) ♀.

Type loc: Poteau, Oklahoma. Types: Coll. G. C. Wheeler, Coll. W. S. Creighton.

Range: Oklahoma to eastern Texas and southern Alabama.

In describing the variety *oklahomensis*, the Wheelers noted that several of the definitive characteristics were prone to vary. About the only satisfactory distinction which was given was the paler color. An examination of the types of both *pluteicornis* and *oklahomensis*, which the Wheelers very generously sent to me, has convinced me that *oklahomensis* is no more than a color variety of *pluteicornis*. Very little is known about the range of *oklahomensis* but the fact that both it and *pluteicornis* were taken at Poteau, Oklahoma, argues against the possibility that *oklahomensis* is a geographical race. In my opinion it is best treated as a synonym of *pluteicornis*.

23. Aphaenogaster (Attomyrma) uinta Wheeler

A. uinta Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 517 (1917) ♀ ♀ ♂.

Type loc: East Mill Creek, Salt Lake County, Utah. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.

Range: southern Utah and southwestern Colorado north to Idaho.

This insect prefers to nest in fully exposed areas of great aridity. It is one of the few ants that appear to thrive in the immediate vicinity of Great Salt Lake.

Genus NOVOMESSOR Emery

(Plate 19, figures 1–4)

The habits of the ants belonging to the genus Novomessor were discussed in a paper published by Dr. W. M. Wheeler and the writer in 1934. The two species which occur in western Texas and the southern portions of New Mexico and Arizona are large and conspicuous insects with habits which differ rather notably from those of many xerophilous genera. The insects are remarkably deliberate in their movements. When foraging they stalk slowly about and show little sign of excitement, even when disturbed. During the summer months much of the foraging is done at night. The ants usually return to the nest during the forenoon and remain in it until the heat of the day is over. The nests are extraordinary. The main nest passage usually consists of a shaft three or four inches in diameter. The walls of this shaft are very rough and it is ordinarily rather crooked. It looks more like a rat's burrow than the entrance to an ant's nest. If the nest is free in the soil, as is almost always the case with those of *cockerelli*, there is a large but thin disc of gravel spread around the opening. The discs of *albisetosus* are smaller than those of *cockerelli* and *albisetosus* will sometimes nest under stones, which *cockerelli* rarely does. Both species appear to be omnivorous and there is little to indicate that they harvest seeds, as so many desert-dwelling species do. The nests of *cockerelli* are usually situated on flats at the base of desert ranges. Those of *albisetosus* are more often found on the lower slopes of such ranges.

Key to the species of Novomessor

1. Head, exclusive of the mandibles, slightly or not at all longer than broad with wavy, longitudinal rugae extending almost to the occipital border, the occipital area granulose ..... *albisetosus*
   Head, exclusive of the mandibles, at least one and one-third times as long as broad with the wavy longitudinal rugae well-developed only in the anterior half of the head; the posterior half with much feebler rugae which are replaced towards the occiput with fine, coriaceous sculpture... *cockerelli*

1. NOVOMESSOR ALBISETOSUS (Mayr)

Aphaenogaster albisetosus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 446 (1886) ♀.

N. albisetosus Emery, Rend. Accad. Sci. Bologna, p. 731 (1915); Emery, in Wytsman Genera Insectorum, Fasc. 174, pl. 1, fig. 16 (1921) ♂; Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 349, pl. 1, fig. 3 (1934) ♀ ♀ ♂.

N. cockerelli var. *minor* Enzmann, Jour. N. Y. Ent. Soc., Vol. 55, No. 2, p. 148, pl. 8 (1947) ♀.

Ischnomyrmex albisetosus Wheeler, Ants, Columbia Univ. Press, p. 280 (1910).

Type loc: New Mexico. Types: none in this country.

Range: southwestern Texas to southern Arizona. Although there appear to be no Mexican records for this species, it must occur in the highlands of Chihuahua. It is abundant in the Chisos Mountains and can scarcely be absent from the barren Sierra del Burro which lies just across the Rio Grande a few miles to the south.

There are several highly confusing points concerning the insect which Miss Jane Enzmann described in 1947 as *Novomessor cockerelli* var. *minor*. The type locality was given as Corpus Christi. It is unthinkable that a representative of Novomessor should occur at sea level and hundreds of miles to the east of its range. Nevertheless the figure which Miss Enzmann presented is clearly that of *Novomessor albisetosus*. I have taken the view that in this case the figure is more reliable than the locality record. It should be borne in mind, however, that no reliance can be placed on Miss Enzmann's work. She has thrown together in a single key, species belonging to the genera Novomessor, Veromessor and Aphaenogaster. No reason was given as to why this was done nor has any been supplied to explain why each genus is only partially represented. When I first examined this key I was inclined to believe that Miss Enzmann had rejected the revisionary proposals which W. M. Wheeler and I published for Novomessor and Veromessor in 1934. It seemed possible that she had returned to Emery's older view which held Veromessor to be a subgenus of Novomessor. A further consideration of Miss Enzmann's work has forced me to a much more distasteful conclusion. I believe that there are no revisionary implications in Miss Enzmann's key and that its peculiar character is an outcome of a total lack of appreciation for the definitive features of the species involved. The key is wholly without merit and is a stumbling block in the path of those seeking an acquaintance with the species covered. It is mentioned here only because there seems to be no other way of countering the damage which this wretched piece of taxonomic work may do.

2. Novomessor cockerelli (E. André)

Aphaenogaster cockerelli E. André, Rev. Ent., p. 150 (1893) ♀.

N. cocquerelli Emery, Rend. Accad. Sc. Bologna, p. 73 (1915).

N. cockerelli Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 352, pl. 1, fig. 1, 4 (1934) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 554, pl. 6, fig. 24 (1947) ♀.

Ischnomyrmex cockerelli Wheeler, Ants, Columbia Univ. Press, p. 280, fig. 155 (1910) ♀ ♀ ♂.

Aphaenogaster sonorae Pergande, Proc. Calif. Acad. Sci. (2), Vol. 4, p. 34 (1895) ♀.

Type loc: Montezuma, Chihuahua, Mexico. Types: none in this country.
Range: western Texas to southern Arizona and south into Mexico.

Genus VEROMESSOR Forel

(Plate 20, figures 1–4)

There is much discrepancy in our knowledge of the five species of Veromessor which occur in the United States. Two of the species, *V. andrei* and *V. pergandei*, are well known insects, which are represented in American collections by abundant material. They have been repeatedly studied in the field and the literature contains several accounts of their habits. In contrast, the species *stoddardi*, *chamberlini* and *lobognathus* are known from exceedingly limited material. Not only are they poorly represented in collections but their habits are very imperfectly understood or entirely unknown. The following account is, of necessity, based on the habits of *andrei* and *pergandei*.

Both these species produce flourishing colonies. They are active ants and harvest large quantities of seeds. The nests of *pergandei* are usually surmounted by a mound or crater of excavated soil. Those of *andrei* may or may not have a mound. If no mound is present there is usually an irregular disc of gravel around the nest entrance. *V. pergandei* will usually make a neat pile of chaff with the husks of the seeds which it has stored in its nest. This chaff pile may be semicircular or it may form a ring which completely encircles the nest. *V. andrei* also makes chaff piles at the entrance to the nest but these are generally more ragged than those of *pergandei* and not infrequently *andrei* will scatter the chaff about, without attempting to build it into a pile.

Both Wheeler (1910) and Cole (1934) have observed that the major harvesting activities of *pergandei* take place in the early morning and the late afternoon. During these periods long files of workers leave the nest and gather seed from the surrounding vegetation. Towards midday the foraging columns dwindle but the activity of the ants in the vicinity of the nest continues during the noon hours. Excavated soil is added to the mound and seed husks are brought out of the nest and placed on the chaff pile. In the writer's opinion, *V. pergandei* shows much less tendency toward midday estivation than do many of our desert species. It would appear that *pergandei* exhibits this response only when the temperature is exceptionally high. The ordinary

midday temperatures during the summer months seem to have little effect on this species. The writer has observed it working outside the nest in the southern Mojave Desert during the midday hours in early August. Mallis (1941) has reported similar observations. The large number of records for this species from areas of high temperature and exceptional aridity show that *pergandei* can endure extreme desert conditions. It appears to be at home not only in the Mojave Desert but in the even hotter Imperial Desert as well. Any species which can live in the latter area may certainly qualify as a fully developed xerophile. *V. andrei* is much less xerophilous. Although it occurs along the northern periphery of the Mojave Desert, it seems unable to tolerate the more drastic conditions which occur to the south.

Key to the species of Veromessor

1. Head largely or entirely covered with coarse, wavy, longitudinal rugae, the interrugal spaces coriaceous or granulose 3
   Head entirely covered with fine longitudinal striae which are interrupted by punctures 2
2. Dorsum of the pronotum without striae, the surface delicately shagreened and strongly shining; color black or piceous brown ..... *pergandei*
   Dorsum of the pronotum longitudinally striate, feebly shining; color reddish brown ..... *stoddardi*
3. Rugae at the midline of the head approximately straight and not diverging behind; the interrugal spaces over the entire head strongly coriaceous, the surface dull ..... *lobognathus*
   Rugae at the midline of the head as coarse and wavy as those elsewhere and distinctly diverging behind; the interrugal spaces granulose and feebly shining 4
4. Proximal portion of the antennal scape ending in a flattened, spatulate lobe; head as broad as long ..... *chamberlini*
   Proximal portion of the antennal scape ending in a trumpet-like flange; head longer than broad 5
5. Antennal scapes in repose just reaching the occipital border; color blackish red to clear red ..... *andrei*
   Antennal scapes in repose slightly surpassing the occipital border; color castaneous brown to brownish yellow ..... *andrei* subsp. *castaneus*

1. Veromessor andrei (Mayr)

Aphaenogaster andrei Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 443 (1886) ♀.
Stenamma (*Messor*) *andrei* Emery, Zool. Jahrb. Syst., Vol. 8, p. 306 (1895) ♀.
Novomessor andrei Emery, Rend. Accad. Sci. Bologna, p. 73 (1915).

Novomessor (*Veromessor*) *andrei* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 51, p. 235 (1917).

Veromessor andrei Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 362, pl. 2, fig. 2 (1934) ♀.

Type loc: California. Types: none in this country.

Range: California, from the San Diego region to the Oregon border with an eastern extension north of the Mojave Desert which runs through Nevada into northwestern Arizona.

2. Veromessor andrei castaneus Wheeler and Creighton

V. andrei subsp. *castaneus* Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 365 (1934) ♀.

V. andrei subsp. *flavus* Wheeler and Creighton, Ibid., p. 366 (1934) ♀.

Type loc: Jucumba, California. Types: M.C.Z., Coll. W. S. Creighton.

Range: known only from the San Diego region in California.

The status of *castaneus* is at present problematical. I have attempted to improve the existing situation by making *flavus* a synonym of *castaneus* for it now seems clear that both these forms cannot be considered as valid subspecies. Both occur in the same area in southern California, but this difficulty is more easily handled than the fact that the typical *andrei* occurs there also. There is no doubt that *castaneus* differs in structure from the typical *andrei* but these differences are scarcely what one would expect in the case of a separate species. The largest workers of *castaneus* are smaller than those of *andrei*, the antennal scapes of *castaneus* are longer, its epinotal suture is less deeply impressed and the ventral tooth and lamella on the petiole are small or absent. These differences are what would be expected of a subspecies. Since it is entirely possible that the range of *castaneus* lies for the most part in Lower California, it may be provisionally retained as a subspecies until we know more of the ants of that region.

3. Veromessor chamberlini (Wheeler)

Messor chamberlini Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 410 (1915) ♀.

V. chamberlini Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 366, pl. 2, fig. 5 (1934) ♀.

Type loc: Santa Cruz Island, California. Types: M.C.Z., Coll. W. S. Creighton.

Range: known only from type material.

4. Veromessor lobognathus (Andrews)

Messor lobognathus Andrews, Psyche, Vol. 23, No. 3, p. 81 (1916) ♀.
V. lobognathus Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 371, pl. 2, fig. 6 (1934) ♀.
Type loc: Glenwood Springs, Colorado. Type: M.C.Z.
Range: nothing positive known, see below.

Most of what is known about the range of *lobognathus* at present is highly perplexing. According to Andrews, the four workers which form the type series of *lobognathus* were taken by T. D. A. Cockerell at Glenwood Springs, Colorado. It is not surprising that Professor Cockerell should have turned up a new species of ant, for he frequently did so. But it is surprising that this species should have belonged to a genus which is so largely confined to California. Glenwood Springs lies about fifty miles to the west of the main chain of the Rockies. Yet there is a gap of five hundred miles which separates this station from the easternmost record of any other species belonging to Veromessor. I found this fact so peculiar that in 1932 some time was spent trying to rediscover *lobognathus* at Glenwood Springs. My failure to find it there proves nothing, of course, except that the insect is not abundant in its supposed type locality. Lately, some even more peculiar data has come to light. I have seen three specimens of *lobognathus* which, if one can believe the locality label, were taken in Missouri. The record from Glenwood Springs was odd enough but the one from Missouri is simply beyond belief. We are badly in need of accurate information on the distribution of *lobognathus* and, until such information can be obtained, there is little point in speculating on the range of this species.

5. Veromessor pergandei (Mayr)

Aphaenogaster pergandei Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 444 (1886) ♀.
Stenamma (*Messor*) *pergandei* Emery, Zool. Jahrb. Syst., Vol. 8, p. 307 (1895) ♀.
Novomessor pergandei Emery, Rend. Accad. Sci. Bologna, p. 73 (1915).
Novomessor (*Veromessor*) *pergandei* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 51, p. 234 (1917).
V. pergandei Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 347, pl. 2, fig. 3 (1934) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 554, pl. 6, fig. 25 (1947) ♀.
Type loc: California. Types: worker, none in this country; female and male, M.C.Z., Coll. W. S. Creighton.
Range: deserts of southwestern Arizona, southern California and Lower California.

6. Veromessor stoddardi (Emery)

Stenamma (*Messor*) *stoddardi* Emery, Zool. Jahrb. Syst., Vol. 8, p. 307 (1895) ♀.
Novomessor (*Veromessor*) *stoddardi* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 51, p. 235 (1917).
V. stoddardi Wheeler and Creighton, Proc. Amer. Acad. Arts Sci. Boston, Vol. 36, p. 385, pl. 2, fig. 1 (1934) ♀.
Type loc: San Jacinto, California. Types: U.S.N.M., M.C.Z., Coll. W. S. Creighton.
Range: known only from the San Diego region of California.

Genus Pheidole Westwood

(Plate 21, figures 1–6)

Unlike most large myrmicine genera, Pheidole has not yielded easily to subgeneric division. Although at least eight subgenera have been recognized, all of them have been small groups. The eight taken together contain less than ten percent of the species. Thus more than ninety percent of the several hundred species still remain in the subgenus Pheidole. When Emery published the first myrmicine section of the *Genera Insectorum* in 1921 he attempted to improve this situation by dividing the subgenus Pheidole into twelve groups. It is not often that Emery placed expediency ahead of phyletics but in this case the desperate complexity of the subgenus Pheidole seems to have driven him to do so. The recognition of these groups involves the joint use of distributional data and structure. At first sight the arrangement looks remarkably like many others which Emery advocated. There is, however, a distinct difference. In other genera Emery's groups are characterized by sufficient structural distinction to enable them to be recognized regardless of the zoögeographical region where they occur. Hence the same group may be present on two or more continents and its recognition does not depend on its geographical affinities. This situation is reversed in the case of the groups in Pheidole. The major division is one of geography. The Old World species are separated from those of the New World and, within each of these two segments, subgroups based upon structure are set up. From a practical point of view this arrangement has its advantages but from a phyletic standpoint it is unsatisfactory. There is a sound reason why no attempt has been made to elevate Emery's groups into subgenera. No plan which rules out the possibility of relationship between Old and New World species is likely to find many champions however useful it may be.

The writer doubts that Emery's arrangement is of much service from a practical point of view. I have found it virtually impossible to utilize the distinctions on which Emery based his groups as major key splits. I do not doubt that this could be done, but it would involve the peculiar situation in which the distinctions between species are more striking than those which separate the major groups. For this reason I have made no attempt, either in the key or in the body of the text, to utilize Emery's groups to distinguish our species. Anyone who is interested in a group arrangement should consult the *Genera Insectorum* (Fasc. 174) where Emery's plan may be studied in detail. The alternative has been to construct a single, very long key covering all our species. I admit that the length of this key is objectionable but I have been assured by people who have tried it that it works. If so, it fulfills the principal function for which it was designed. If anyone ever undertakes the herculean task of monographing the genus Pheidole, we may be able to improve the present situation and base our keys on phyletic characteristics. Until that time it seems best to treat the subgenus Pheidole as a single unit.

Most of our species of Pheidole possess a dimorphic worker caste with the major and minor workers not connected by intermediates. In a few species, however, the worker caste is polymorphic (*kingi instabilis* and *torpescens, vasliti arizonica*, etc.). Most of the species garner seeds and it is believed that the large-headed major workers function as seed-huskers. The enlarged head of the major is mainly filled with mandibular muscles. This enables the jaws to exert much pressure, which should be useful in cracking off the husks of seeds. It may be added that sometimes the head of the major is so large in proportion to its body that if the insect is turned over on the back of its head it cannot regain a normal posture without help from other workers. Despite their preference for a graminivorous diet many species of Pheidole will accept other food as well. They seem less attracted to honey-dew than do many ants but will often feed voraciously on animal tissue when the opportunity offers. The majority of our species form small colonies. In many cases there are only about two or three hundred individuals in a fully developed nest. Even in the case of the species which produce comparatively large nests (*morrisi, hyatti, desertorum* etc.) a colony of more than two or three thousand individuals would be exceptionally large. By far the majority of our species nest in soil. The nest may be built under a stone or in open soil without a covering object. In the latter case there is often a mound or crater of excavated soil surrounding the nest entrance. The eastern species *dentata* will nest in rotten logs as well as soil but such flexibility in nesting habit is exceptional.

Key to the species of Pheidole

1. Gaster not truncate at the base (Subgenus *Macropheidole*) ..... *rhea*
   Gaster truncate or subtruncate at the base (Subgenus *Pheidole*) 2
2. Head of the major cylindrical in cross-section and obliquely truncated in front ..... *lamia*
   Head of the major not cylindrical in cross-section and not obliquely truncated in front 3
3. Scapes of the major reaching or surpassing the occipital angles 4
   Scapes of the major not reaching the occipital angles 5
4. Upper surface of the head of the major densely granulo-rugose and dull; epinotal spines slender and directed upward ..... *grallipes*
   Upper surface of the head of the major with prominent longitudinal rugae, the interrugal spaces not granulose or at most very feebly granulose with the surface shining; epinotal spines thick at the base and directed backward ..... *desertorum*
5. Antennal scape of the major laterally bent at the base so that the scape turns toward the midline of the head in passing to the antennal socket, the flattened basal portion as wide as the distal part of the scape 6
   Antennal scape of the major not laterally bent at the base or, if slightly bent and flattened, the flat part is not as wide as the distal portion of the scape 14
6. Antennal scape of the major reaching three-quarters or more of the distance between its insertion and the occipital angle 7
   Antennal scape of the major reaching two-thirds or less of the distance between its insertion and the occipital angle 11
7. The entire upper surface of the head of the major covered with reticulo-rugose sculpture, the interrugal spaces granulose 8
   The reticulo-rugose sculpture largely confined to the anterior half of the head in the major, the occipital lobes punctate or feebly granulose, the surface moderately to strongly shining at least in the posterior half of the head 9
8. Head of the minor densely sculptured and completely opaque; the postpetiole transversely oval and twice as wide as the node of the petiole ... *texana*
   Head of the minor in part strongly shining, the sculpture nowhere very dense; the postpetiole globular and less than twice as wide as the node of the petiole ..... *cockerelli*
9. Head of the minor densely punctate, opaque; erect hairs on the gaster of the major sparse and widely spaced ..... *vallicola*
   Head of the minor smooth and shining; erect hairs on the gaster of the major numerous, long and closely spaced 10
10. Head of the major measuring 1.4 mm. x 1.3 mm.; female 7 mm. in length *hyatti*
    Head of the major measuring 1.2 mm. x 1.1 mm.; female 5 mm. in length *hyatti* subsp. *solitanea*

11. The occipital lobes of the major striato-granulose and scarcely shining.. *vasliti* subsp. *arizonica*[1]
    The occipital lobes of the major strongly shining and bearing piligerous punctures only 12
12. The flattened basal portion of the scape of the major notably broader than the distal portion ..... *porcula*
    The flattened basal portion of the scape of the major no wider than its distal portion 13
13. Erect gastric hairs, when present, much longer and coarser than the fine appressed pubescence ..... *crassicornis*
    Erect gastric hairs very numerous, rather short and so fine that they merge with the pubescence most of which is semierect ..... *crassicornis* subsp. *tetra*
14. The tops of the occipital lobes of the major, and usually their front faces as well, covered with sculpture, the surface opaque or feebly shining.. 15
    The tops of the occipital lobes of the major, and usually their front faces as well, free from sculpture except for piligerous punctures, the surface in most cases strongly shining 30
15. The anterior margin of the clypeus of the major with a deep, semicircular impression which extends inward almost to the level of the frontal lobes 16
    The anterior margin of the clypeus of the major entire, or if impressed the impression is shallow and not semicircular 17
16. Head of the major with parallel sides except for a very slight narrowing in front of the eyes ..... *kingi* subsp. *instabilis*
    Head of the major notably narrowed in its anterior half ..... *kingi* subsp. *torpescens*
17. Humeral angles of the pronotum of the major feebly developed and not forming lateral bosses 18
    Humeral angles of the pronotum of the major strongly developed and forming distinct, epaulet-like lateral bosses 20
18. Posterior half of the head of the minor without sculpture except for piligerous punctures ..... *sitarches*
    Posterior half of the head of the minor striate or densely punctato-granulate 19
19. Head of the minor striate posteriorly ..... *sitarches* subsp. *soritis*
    Head of the minor punctate posteriorly ..... *sitarches* subsp. *campestris*
20. Postpetiole in the major lenticular, the lateral connules well-developed.. 21
    Postpetiole in the major trapezoidal, the lateral connules absent or poorly developed 26
21. Occipital sculpture of the major reticulate with no trace of transverse rugae or striae; head of the major 0.85 mm. in length ..... *dentigula*
    Occipital sculpture of the major, even when reticulate, with the rugae so

[1] The strongly polymorphic worker caste of *arizonica* is a source of considerable confusion. The larger medias would run out in the key to *hyatti* or *cockerelli*, from which they would differ through the more rugose occipital lobes. The smaller medias approach the condition found in the major of *desertorum* but have shorter and more numerous erect hairs on the thorax and gaster. The minors are almost impossible to distinguish from those of *hyatti*.

arranged that they appear as transverse ridges; head of the major 1.4 mm. or more in length 22

22. Transverse rugae on the occiput of the major prominent and usually extending well onto the front face of the lobes 23
Transverse rugae on the occiput of the major feeble, sometimes replaced by transverse rows of small granules, the transverse sculpture in either case largely confined to the top of the occiput 25

23. Interrugal sculpture on the front and vertex of the major consisting of dense granulations only ..... *tepicana* subsp. *cavigenis*
Interrugal sculpture on the front and vertex of the major consisting of coarse, oval foveae as well as granulations 24

24. Head of the major with longitudinal rugae extending entirely across the vertex; interrugal spaces on the vertex finely punctured and scarcely shining ..... *pilifera*
Head of the major with the longitudinal rugae not crossing the vertex, the latter area distinctly shining with sparse, coarse punctures ..... *pilifera* subsp. *artemisia*

25. The portion of the head of the major in front of the occipital lobes with numerous, coarse foveae and granulations, the surface at most feebly shining ..... *pilifera* subsp. *coloradensis*
The portion of the head of the major in front of the occipital lobes with only small, piligerous punctures, the surface strongly shining ..... *pilifera* subsp. *pacifica*

26. Occipital rugae of the major turning forward onto the cheeks and continuing across them to the insertion of the mandibles ..... *californica* subsp. *micula*
Occipital rugae of the major not turning forward onto the cheeks, the latter shining, punctate but not striate 27

27. Sides of the epinotum in the major granulose, feebly shining or opaque .. 28
Sides of the epinotum in the major not granulose, very smooth and shining ..... *californica* subsp. *pyramidensis*

28. Occipital rugae in the major coarse and wavy, usually forming reticulations in the occipital sulcus 29
Occipital rugae in the major finer, straight or nearly so and not usually forming reticulations in the occipital sulcus .. *californica* subsp. *oregonica*

29. Hairs on the petiole and postpetiole of the major little or no longer than those elsewhere ..... *californica*
Hairs on the petiole and postpetiole of the major notably longer than those elsewhere ..... *californica* subsp. *shoshoni*

30. Head, thorax and gaster of the minor, and often of the major as well, with distinct violaceous or bluish reflections 31
Violaceous reflections not present 32

31. Head of the minor in large part sculptured, only a narrow central strip smooth and shining ..... *metallescens*
Head of the minor largely smooth and shining ..... *metallescens* subsp. *splendidula*

32. Entire thorax of the minor densely covered with granulose sculpture and

completely opaque 33
At least the top of the pronotum of the minor shining or, if the entire thorax is opaque, the promesonotum is longitudinally striate and not densely granulose 41

33. Antennal scapes of the minor surpassing the occipital border by an amount twice as great as the length of the first funicular joint 34
Antennal scapes of the minor just reaching the occipital border or, if they surpass it, the amount is no greater than the length of the first funicular joint 35

34. Vertex of the major densely sculptured, opaque ..... *sciophila*
Vertex of the major largely smooth and shining, the sculpture consisting of scattered patches of fine punctures... *sciophila* subsp. *semilaevicephala*

35. Postpetiole of the minor, seen from above, spherical 36
Postpetiole of the minor, seen from above, not spherical 37

36. Occipital lobes of the major smooth and shining ..... *davisi*
Occipital lobes of the major striate on their anterior portions... *nuculiceps*

37. Antennal scapes of the minor just reaching the occipital border or surpassing it by an amount much less than the length of the first funicular joint 38
Antennal scapes of the minor surpassing the occipital border by an amount equal to the length of the first funicular joint 39

38. Pronotum of the major with delicate transverse rugae in addition to the punctures; erect hairs short and blunt ..... *constipata*
Pronotum of the major punctate only; erect hairs long and pointed.... *anastasii*

39. Postpetiole of the minor, seen from above, transversely oval... *proserpina*
Postpetiole of the minor, seen from above, shaped like a truncated cone. 40

40. Head of the minor subquadrate, the middle of the occiput slightly concave *floridana* subsp. *lauta*
Head of the minor notably narrowed in its anterior half, the middle of the occiput flat ..... *floridana*

41. Epinotum of the major angular at the junction of the basal and declivious faces but the angles not produced into distinct teeth or spines..... 42
Epinotum of the major armed with distinct teeth or spines 44

42. Prothorax of the major with very well-marked humeri; the postpetiole with prominent lateral connules ..... *barbata*
Prothorax of the major without prominent humeri; the postpetiole without prominent lateral connules 43

43. The abdominal pilosity largely limited to coarse erect hairs; length of the major 3.5–4 mm. ..... *morrisi*
The abdomen with many fine subappressed hairs in addition to the coarse erect ones; length of the major 4–5 mm. ..... *morrisi* subsp. *impexa*

44. Large species, the head of the major at least 2 mm. in length and usually more 45
Small species, the head of the major not exceeding 1.5 mm. in length and usually less 50

45. Pronotum of the major with transverse striae 46
Pronotum of the major without transverse striae 47

46. Head of the major with the longitudinal rugae confined to the anterior half, the posterior half without sculpture except for small piligerous punctures ..... *virago*
Head of the major with the longitudinal rugae extending onto the anterior parts of the occipital lobes ..... *titanis*
47. Postpetiole of the major, seen from above, very strongly transverse, notably constricted behind, with the prominent lateral connules sharply pointed ..... *spadonia*
Postpetiole of the major, seen from above, only moderately transverse, not greatly constricted behind, with the lateral connules short and rather blunt 48
48. Head of the major notably longer than broad (2.2 mm. x 1.6 mm.); the genae suddenly expanded just behind the insertion of the mandibles.... *ridicula*
Head of the major very little longer than broad (2.2 mm. x 2.1 mm.) or broader than long; the genae not expanded above the insertion of the mandibles 49
49. Head of the major with a flattened, rugose area extending rearward between the frontal lobe and the eye; promesonotum angular in profile.... *macclendoni*
Head of the major without the flattened area described above; promesonotum evenly rounded in profile ..... *militicida*
50. Sculpture on the head of the major extending to the vertex, only the occiput smooth and shining ..... *ceres*
Sculpture on the head of the major largely confined to the anterior half of the head, the posterior half smooth and shining 51
51. Mesonotum of the major depressed below the adjacent portion of the pronotum so that in profile it forms a distinct step or angular projection between the pronotum and the epinotum ..... *dentata*
Mesonotum of the major not depressed below the adjacent portion of the pronotum, in profile the two forming an evenly curved outline which usually descends abruptly at the mesoepinotal suture 52
52. Eyes of the major with 60 or more facets 53
Eyes of the major with 40 or less facets 54
53. Pronotum of the major with the transverse striae largely confined to the anterior face, the dorsum smooth and shining ..... *xerophila*
Pronotum of the major entirely covered with transverse striae, feebly shining or opaque ..... *xerophila* subsp. *tucsonica*
54. Vertex and occiput of the minor with small, close-set punctures which give the surface a notably duller appearance on those parts than elsewhere on the head 55
Vertex and occiput of the minor as strongly shining or only slightly less shining than the rest of the head, the punctures widely scattered over the whole surface of the head 56
55. Basal face of the epinotum of the major sculptured and opaque.... *casta*
Basal face of the epinotum of the major in large part shining, its sculpture restricted to punctures near the mesoepinotal suture ..... *cerebrosior*

56. Basal face of the epinotum of the major free from sculpture and strongly shining ..... *humeralis*
Basal face of the epinotum of the major distinctly sculptured, feebly shining or opaque 57
57. Sides of the epinotum in the minor largely free from sculpture and strongly shining ..... *tysoni*
Sides of the epinotum in the minor densely punctured, feebly shining or opaque 58
58. Lateral connules of the postpetiole of the major prominent and sharp pointed ..... *pinealis*
Lateral connules of the postpetiole in the major blunt and not prominent 59
59. Erect hairs on the thorax of the minor short, sparse and strongly clavate *marcidula*
Erect hairs on the thorax of the minor long, abundant and, although often blunt at the tip, not clavate 60
60. Basal face of the epinotum in the major largely punctate, transverse striae, when present, confined to the area between the bases of the epinotal spines; rugae of the pronotum feeble or absent 61
Basal face of the epinotum in the major largely covered with transverse striae, the punctures restricted to the region of the mesoepinotal suture; rugae of the pronotum coarse and prominent ..... *bicarinata*
61. Epinotum of the minor armed with thick, short spines 62
Epinotum of the minor armed with angular teeth which are broad at the base and do not resemble spines ..... *bicarinata* subsp. *longula*
62. Major castaneous brown to piceous brown, minor sordid yellow to piceous brown ..... *bicarinata* subsp. *buccalis*
Major clear yellow to yellowish brown, minor usually clear yellow ..... *bicarinata* subsp. *vinelandica*

Subgenus MACROPHEIDOLE Emery

1. PHEIDOLE (MACROPHEIDOLE) RHEA Wheeler

Ph. rhea Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 452 (1908) ♀.

Ph. (*Macropheidole*) *rhea* M. R. Smith, Proc. Ent. Soc. Wash., Vol. 45, No. 1, p. 7 (1943) ♀ ♂ ♀.

Ph. fimbriata Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 403 (1915) (not Roger).

Type loc: Nogales, Arizona. Types: female, Coll. Cornell Univ.; major and minor, U.S.N.M.

Range: southern Arizona south into Mexico.

The records for *rhea* indicate a rather surprising tolerance for elevation. The insect has been taken in stations as low as 3700 feet and

as high as 7000 feet. The majority of the records are about 4000 feet. The insect prefers to nest on plateaus or among foot hills at the base of mountains.

In a paper published in 1943 (*loc. cit.*) Dr. M. R. Smith has cleared up much of the confusion which surrounded Wheeler's treatment of this species. Although Wheeler described *rhea* from a single deälated female taken at Nogales, Arizona, he later synonymized the species with Roger's *fimbriata*. This was done through comparison with a series of specimens taken at Cuatolopaz, Vera Cruz, Mexico. This series contains major and minor workers as well as winged females. The association with *fimbriata* was, presumably, made on the basis of the worker and major. According to Dr. Smith, Wheeler later realized he had been in error in synonymizing the two species for, although he never corrected his mistake, he continued to use the name *rhea* in identifying specimens from Arizona and Mexico. Working in conjunction with Dr. L. G. Wesson, Dr. Smith was able to show that *rhea* is specifically distinct from another species of Macropheidole which occurs in Mexico. The long series of differences in female, major and minor which Dr. Smith presented leaves no room for doubt on this score. But it may be doubted that this Mexican species is the same as Roger's *fimbriata*. The latter insect was originally described from material taken at Rio Paraguay and while it seems to be fairly abundant in northern Argentina, Paraguay and southern Brazil, there is little to indicate that it has a continuous range through South and Central America which would connect it with the Mexican specimens. If Roger's types are still in existence the problem can be solved by consulting them. But until this can be done the possibility must be considered that Mexican material at present assigned to *fimbriata* may represent a third species of Macropheidole. The important point is, however, that Dr. Smith has shown that *rhea* is a valid species and that Wheeler's synonymy of this insect with *fimbriata* must be disregarded.

Subgenus PHEIDOLE Westwood

2. PHEIDOLE ANASTASII Emery

(Introduced)

Ph. anastasii Emery, Bull. Soc. Ent. Ital., Vol. 28, p. 44 (1896) ♀ ♁; Forel, Mitt. Naturh. Mus. Hamburg, Vol. 18, p. 78 (1901) ♀.
Type loc: Jimenez, Costa Rica. Types: A.M.N.H.
Range: (in the United States) southern Florida.

Like several other tropical importations, *anastasii* has been reported from greenhouses in various parts of the east. It is only in southern Florida that this species finds congenial climatic conditions out-of-doors. It appears to be well established in that state.

3. Pheidole barbata Wheeler

Ph. barbata Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 448 (1908) ♀ ♁.
Type loc: Mojave Desert near Needles, California. Types: A.M.N.H., M.C.Z.
Range: deserts of western Arizona and southeastern California.

4. Pheidole bicarinata Mayr

In dealing with this species the writer has found it necessary to return to Forel's original view concerning the relationship of *vinelandica* to *bicarinata*. I believe that Forel was correct when he described *vinelandica* as a subspecies of *bicarinata* and its subsequent elevation to specific rank has been a hindrance to the correct understanding of this complex. In addition to this change, considerable synonymy has been necessary. Emery's subspecies *laeviuscula* I regard as an intergrade between *bicarinata* and *vinelandica*. Wheeler's variety *castanea* belongs not to *longula* but to *buccalis*, of which it seems to be no more than an insignificant color phase. I consider Smith's *hayesi* as identical with the typical *bicarinata*. Since none of Mayr's types are present in this country, it is difficult to deal with the typical form. I believe that the association is correct, however, since there seems to be only a single race (the typical *bicarinata*) present in the north central states. Wheeler's *cerebrosior*, which was originally described as a subspecies of *vinelandica* has been treated as a separate species. I present below a summary of the arrangement followed in this volume:

Ph. bicarinata Mayr
= *hayesi* M. R. Smith
subsp. *buccalis* Wheeler
= var. *castanea* Wheeler
subsp. *longula* Emery
subsp. *vinelandica* Forel
= subsp. *laeviuscula* Emery

The above arrangement is not without its faults but it has one marked advantage. The forms which are recognized as valid behave as geographical races. They maintain a reasonable constancy of

structure over their respective ranges and intergrade where the ranges join. A clear appreciation of this fact is a great help in handling the confusing intermediate forms which are often encountered in this group. There follows the synonymy of *Ph. bicarinata* Mayr:

Ph. bicarinata Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 989 (1870) ♁; Mayr, Ibidem, Vol. 37, p. 596 (1887) ♁.
Ph. hayesi M. R. Smith, Ent. News, Vol. 35, p. 251 (1924) ♀ ♁.
Type loc: Illinois. Types: none in this country.
Range: Ohio west to Wyoming and Colorado. The southern border of the range appears to correspond roughly with the southern boundaries of Kansas and Missouri. The insect does not appear to occur west of the Rockies.

5. Pheidole bicarinata buccalis Wheeler

Ph. vinelandica subsp. *buccalis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 454 (1908) ♀ ♁ ♀.
Ph. vinelandica subsp. *longula* var. *castanea* Wheeler, Ibidem, Vol. 34, p. 405 (1915) ♀ ♁.
Type loc: Ash Fork and Prescott, Arizona. Types: A.M.N.H., M.C.Z.
Range: Arizona and southern Utah east to Texas.

The subspecies *buccalis* intergrades with *vinelandica* in western Texas. Although the color of *buccalis* varies to some extent, even the lighter specimens are distinctly darker than *vinelandica*. It is also a somewhat smoother insect than *vinelandica* but the difference is not great and, since confusing exceptions are sometimes encountered, this character was not included in the key.

6. Pheidole bicarinata longula Emery

Ph. vinelandica var. *longula* Emery, Zool. Jahrb. Syst., Vol. 8, p. 292(1895) ♀ ♁; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 453 (1908) ♁.
Ph. vinelandica subsp. *longula* Wheeler, Ibidem, Vol. 34, p. 405 (1915).
Type loc: Pueblo, Colorado. Types: A.M.N.H.
Range: western Texas to southeastern Colorado.

There are several puzzling features connected with *longula*. Its range is comparatively limited, with its northern end adjoining that of the typical *bicarinata* and its southern end reaching the area in which *vinelandica* and *buccalis* come in contact. The chances for intergradation are excellent, yet intergrades do not seem to be produced. Subsequent study may prove *longula* to be a separate species,

but the structural differences shown by this variant are of such a minor nature that this seems very unlikely.

7. Pheidole bicarinata vinelandica Forel

Ph. vinelandica Forel, Ann. Soc. Ent. Belg., Vol. 30, C. R. p. 45 (1886) ♀ ♁ ♀ ♂; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 458 (1886); Mayr, Ibidem, Vol. 37, p. 591 (1887) ♀ ♁; Emery, Zool. Jahrb. Syst., Vol. 8, p. 292 (1895); Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 348 (1901) ♀ ♁ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 453 (1908) ♁.

Ph. (*Allopheidole*) *vinelandica* Forel, Mem. Soc. Ent. Belg., Vol. 19, p. 237 (1912).

Ph. laeviuscula Emery, Zool. Jahrb. Syst., Vol. 8, p. 292 (1895) ♀ ♁.

Type loc: Vineland, New Jersey. Types: none in this country. Specimens bearing cotype labels in the A.M.N.H. are from Morgantown, N. C. and do not belong to the type series. They are part of the material on which Forel based his second description of *vinelandica* in 1901.

Range: southern New Jersey to South Carolina, west to Ohio and southwest to Texas. The insect does not occur in the southern portions of the eastern Gulf States or in Florida.

8. Pheidole californica Mayr

We are fortunate that there are present in American collections types of all the variants belonging to this complex except the typical *californica*. This circumstance has undoubtedly saved this group from many of the difficulties which beset such aggregations elsewhere in the genus. It has reduced the need for revisionary work to a minimum. I have thrown the varieties *incenata, satura* and *hagermani* into the synonymy but, aside from these, all the other described variants seem valid. As to whether they should be treated as subspecies is a more difficult question. I have followed Emery and retained them in this category, since our present knowledge of their distribution does not conflict with such a view. It should be remembered, however, that three of the five forms are known from type material only. About all that can be said in such cases is that the areas in which the forms occur are widely separated and that there is nothing to indicate coincidental ranges. It is possible that when we have a better knowledge of the range of some of these variants they may prove to be species rather than subspecies. Wheeler's subspecies *micula*, for example, is a very distinct insect and might be considered a species on the basis of structure alone. Since its range apparently lies well to the south of the rest of the group, it shows distinction in this respect also. The

complex appears to be a very attractive one from a chorological standpoint and it is to be hoped that someone will undertake a study of its characteristics in the field. There follows the synonymy of *Ph. californica* Mayr:

Ph. californica Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 987 (1870) ♀ ♁; Mayr, Ibidem, Vol. 37, p. 588 (1887); Emery, Zool. Jahrb. Syst., Vol. 8, p. 289 (1895); Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 406 (1915) ♀ ♁ ♀.
Ph. californica var. *satura* Wheeler, Ibidem, Vol. 34, p. 407 (1915) ♀ ♁.
Ph. californica var. *incenata* Wheeler, Ibidem, Vol. 34, p. 407 (1915) ♀ ♁.
Type loc: San Francisco, California. Types: none in this country.
Range: California, from San Francisco south to Los Angeles.

The varieties *incenata* and *satura* were both based on slight color differences. I have synonymized them because they appear to be without any geographical significance. Such color differences occur in all parts of the range of the typical *californica* and, in my opinion, Wheeler should never have named them.

9. Pheidole californica micula Wheeler

Ph. californica subsp. *micula* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 408 (1915) ♀ ♁.
Type loc: Miller Canyon, Huachuca Mts., Arizona. Types: M.C.Z, A.M.N.H.
Range: known from type material only.

10. Pheidole californica oregonica Emery

Ph. oregonica Emery, Zool. Jahrb. Syst., Vol. 8, p. 291 (1895) ♀ ♁.
Ph. californica subsp. *oregonica* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 407 (1915) ♀ ♁ ♀.
Ph. californica var. *hagermani* Cole, Ent. News, Vol. 47, No. 5, p. 120 (1936) ♀ ♁.
Type loc: The Dalles, Oregon. Types: A.M.N.H., M.C.Z.
Range: Washington, Oregon and northern Idaho.

Cole's variety *hagermani* belongs to *oregonica* and not to the typical *californica,* as he supposed. I can see no significant difference between the types of *hagermani* and those of *oregonica.*

11. Pheidole californica pyramidensis Emery

Ph. californica subsp. *pyramidensis* Emery, in Wytsman, Genera Insectorum, Fasc. 174, p. 105 (1921) (*nomen novum*).

Ph. californica subsp. *nevadensis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 408 (1915) ♀ ♀. (*nec* Forel).
Type loc: Pyramid Lake, Nevada. Types: M.C.Z., A.M.N.H.
Range: known only from type material.

When Wheeler described this insect as *nevadensis*, he was unaware that Forel had applied the same name to a variety of the South American *Ph. pubiventris* in 1901. The mistake was later corrected by Emery who must, of course, be cited as the author of the species.

12. Pheidole californica shoshoni Cole

Ph. californica var. *shoshoni* Cole, Ann. Ent. Soc. Amer., Vol. 26, No. 4, p. 618 (1933) ♀ ♀.
Type loc: Snake River Canyon, Twin Falls, Idaho. Types: Coll. A. C. Cole, Coll. C. H. Kennedy.
Range: known only from type material.

Since I have not seen type material of *shoshoni* or specimens certainly referable to it, I hesitated to include this subspecies in the key. I believe, however, that it will key out properly on the characters given. This subspecies seems very similar to the typical *californica* and may later prove to be a synonym of it.

13. Pheidole casta Wheeler

Ph. casta Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 454, pl. 26, figs. 22, 23 (1908) ♀ ♀.
Type loc: Canyon of Rio Grande, Langtry, Texas. Types: A.M.N.H., M.C.Z.
Range: known only from type material.

14. Pheidole ceres Wheeler

Ph. ceres Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 10 (1904) ♀ ♀ ♀ ♂.
Type loc: Colorado Springs, Colorado (by present restriction). Types: M.C.Z.
Range: foothills of the Rockies in eastern Colorado southwestward to northern Arizona. This insect has also been reported from the Davis Mountains of Texas but it seems to be very rare in that region.

I have restricted the type locality of *ceres* to Colorado Springs in the hope that this may lead to a clearer concept of the species. Wheeler originally considered specimens from several localities as the types of *ceres*. These specimens are by no means uniform. Those coming from

Boulder are more heavily sculptured than the specimens taken in southern and western stations. As to what these differences mean is not clear at present. The specimens from Boulder may represent a northern race of *ceres* but, as they seem to occur nowhere else, it is inadvisable to attempt this distinction until more is known of the range of this variant. *Ph. ceres* is the host for the workerless parasite *Sympheidole elecebra.*

15. Pheidole cerebrosior Wheeler

Ph. vinelandica subsp. *cerebrosior* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 405 (1915) ♀ ♁.
Type loc: Tucson, Arizona. Types: A.M.N.H., M.C.Z.
Range: known only from the deserts of southern Arizona.

There is little reason why *cerebrosior* should have been related to *vinelandica.* The soldier of *cerebrosior* has a strongly transverse postpetiole in which the lateral connules are very pronounced. Neither feature occurs in *vinelandica.* The minor of *cerebrosior* has antennal scapes which slightly surpass the occipital border. Those of the minor of *vinelandica* fall just short of the occipital border. The minor of *cerebrosior* is also more heavily sculptured than that of *vinelandica.*

16. Pheidole cockerelli Wheeler

Ph. cockerelli Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 464 (1908) ♀ ♁.
Type loc: Arroyo Pecos, Las Vegas, New Mexico (by present restriction). Types: A.M.N.H., M.C.Z.
Range: deserts of Southern New Mexico and Arizona.

17. Pheidole constipata Wheeler

Ph. constipata Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 468 (1908) ♀ ♁ ♀ ♂.
Type loc: Austin and New Braunfels, Texas. Types: A.M.N.H., M.C.Z.
Range: known only from type material.

18. Pheidole crassicornis Emery

Ph. crassicornis Emery, Zool. Jahrb. Syst., Vol. 8, p. 296 (1895) ♁; Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 350 (1901) ♀ ♁ ♂.
Ph. crassicornis var. *diversipilosa* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 467 (1908) ♀ ♁ ♀.

Type loc: Charlotte, North Carolina. Types: none in this country (see below).
Range: the Carolinas southwestward to Texas. The insect has also been reported from eastern Colorado but it is very rare in that state.

There are specimens of *crassicornis* bearing cotype labels in the collections of the M.C.Z. and the A.M.N.H. These specimens were taken at Belmont, North Carolina, hence they are certainly not cotypes. They may be a part of the series on which Forel based his 1901 description of *crassicornis*.

It has been necessary to alter the status of several of the variants which Wheeler assigned to this species. His subspecies *vallicola* and *porcula* have both been treated as separate species. It may be recalled that, because of its very distinct structural features, Wheeler was doubtful that *porcula* belonged to *crassicornis*. The distribution of *porcula* and its behavior in the field both indicate that this insect behaves as a species. The reasons for these changes have been presented under the species involved. I am also unable to see why Wheeler treated *tetra* as an intergrade between *porcula* and *crassicornis*. Actually *tetra* is a western subspecies of *crassicornis* and Wheeler's variety *diversipilosa* is the intergrade which connects *tetra* with the typical eastern *crassicornis*. For this reason *tetra* has been given subspecific rank and *diversipilosa* has been thrown into the synonymy of *crassicornis*. Since a good deal has been said about the lack of erect hairs on the gaster of the typical *crassicornis*, it seems well to note that this is not always the case. Even when erect hairs are present, however, they are notably less abundant than those of the western race *tetra*, hence this difference can still be used as a means for separating the two insects.

19. Pheidole crassicornis tetra Wheeler

Ph. crassicornis subsp. *porcula* var. *tetra* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 467 (1908) ♀ ♁.
Type loc: Austin, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: central Texas to southern Arizona.

It is difficult to see why Wheeler assigned *tetra* to *porcula*, for the two have little in common. The scape of *tetra* is like that of *crassicornis* and *tetra* should have been assigned to *crassicornis* at the start.

20. Pheidole davisi Wheeler

Ph. davisi Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 380 (1905) ♀ ♁.
Type loc: Lakehurst, New Jersey. Types: A.M.N.H., M.C.Z.

Range: southern New Jersey to northern Alabama. In the southern part of the range *davisi* occurs in the valleys of the Appalachian Highlands.

21. Pheidole dentata Mayr

After studying a large amount of material belonging to *dentata* and *commutata,* the writer finds himself in agreement with those myrmecologists who have refused to accept Emery's unsupported statement that *commutata* is a separate species. This vexing difference of opinion need never have arisen. Half a century ago Forel presented good evidence to show that *dentata* and *commutata* cannot be regarded as separate species. It is significant that Forel's conclusion was based on a field acquaintance with this insect. In 1900 Forel visited North Carolina, where he had the opportunity to study *dentata* and to observe the variability which this species exhibits. Forel's opinion in this matter should have carried more weight than those of his European contemporaries, who knew *dentata* only from cabinet specimens. This was not the case. While Emery agreed with Forel that *dentata* should be removed from *morrisi* and given specific rank, he would not agree to including *commutata* with *dentata.* As far as the writer has been able to determine, Emery never presented any reason why he regarded *commutata* as a separate species. This is entirely out of character with Emery's usual caution. It is not surprising that most American myrmecologists have refused to accede to Emery's treatment of *commutata.* There is abundant evidence that Forel was correct in regarding *dentata* and *commutata* as representatives of the same species. There is no lack of material belonging to *dentata* for the insect is one of the most abundant species of Pheidole in the southeastern United States. A very large number of specimens of *dentata* can now be examined in American collections and a study of these will show that Forel's view is far sounder than the stand advocated by Emery. In my opinion, the only trouble with Forel's treatment is that he did not carry his revisionary work far enough. There is no justification for the recognition of *commutata* or *faisonsica,* both of which are based on unstable characters. Over its entire range *dentata* produces variations in color and the length of the epinotal spines. Not only are these variations entirely devoid of geographical significance but they are so frequently encountered that it is impossible to regard them even as nest varieties. In most nest series of *dentata* there will be specimens referable to *commutata* or *faisonsica.* What must be realized is that in *dentata* both color and spine length are too variable to be used as satisfactory criteria for infraspecific delimitation. There follows the synonymy of *Ph. dentata* Mayr:

Ph. morrisi var. *dentata* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 457 (1886) ♀ ♀ ♂.

Ph. dentata Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 351 (1901) ♀ ♀ ♂.

Ph. dentata var. *faisonsica* Forel, Ibidem, p. 352 (1901) ♀ ♀.

Ph. commutata Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 459 (1886) ♀ ♀; Mayr, Ibidem, Vol. 37, p. 598 (1887); Emery, Zool. Jahrb. Syst., Vol. 8, p. 289 (1895) ♀ ♀.

Leptothorax tennesseensis Cole, Amer. Mid. Naturalist, Vol. 19, p. 238 (1938) ♀; Cole, Proc. Ent. Soc. Wash., Vol. 50, No. 4, p. 82 (1948) (synonymic note).

Type loc: Florida. Types: none in this country.

Range: North Carolina to Florida and westward through Tennessee and the Gulf States to eastern Texas.

I have used the presence of epinotal spines to separate *dentata* from *morrisi* in the key, since this is the most convenient difference for keying. Even though the length of the epinotal spines is variable in *dentata*, there is nothing to indicate that the epinotum is ever unarmed. Conversely, the epinotum of *morrisi* never bears spines, hence there is little likelihood of confusing the two species if epinotal armature is used as a separatory character. The other differences which distinguish *dentata* from *morrisi* are matters of proportion which are difficult to express in a key.

Forel was of the opinion (1901) that *dentata* always nests in old logs and never constructs nests in the soil surmounted by masonry domes. This statement is in need of considerable modification. It is true that *dentata* often nests in rotten logs and old stumps and, under such circumstances, it does not construct a mound of excavated soil above the nest. But *dentata* also nests in soil and when it does the nest usually has a mound of excavated earth above it. As has been noted elsewhere this flexibility of nesting habits is unusual in a species of Pheidole, for most members of this genus nest only in soil.

22. Pheidole dentigula M. R. Smith

Ph. dentigula M. R. Smith, Ent. News, Vol. 38, p. 310 (1927) ♀ ♀; M. R. Smith, Ibidem, Vol. 39, p. 245 (1928) ♀.

Type loc: A & M College, Mississippi. Types: Coll. M. R. Smith.

Range: Tennessee southward through Alabama and Mississippi. The insect apparently does not occur to the east of the Appalachian Highlands.

23. Pheidole desertorum Wheeler

Ph. desertorum Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 22, p. 337 (1906) ♀ ♀ ♀ ♂.

Ph. desertorum var. *comanche* Wheeler, Ibidem, p. 339 (1906) ♀ ♀.

Ph. desertorum var. *maricopa* Wheeler, Ibidem, p. 339 (1906) ♀ ♎.
Type loc: Ft. Davis, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: western Texas to Arizona.

The two color varieties, *comanche* and *maricopa*, which Wheeler established when he first described *desertorum*, should not, in my opinion, be recognized as valid forms. When *maricopa* was first described there might have been reason to believe that this form is a light colored western race of *desertorum*. At that time the range of *maricopa*, which was described from the Grand Canyon of Arizona, seemed to lie well to the west of those of the typical *desertorum* and *comanche*. As more material has come into collections the ranges of all three forms have tended more and more to become coincidental. The only difference appears to be that the pale forms, referable to *maricopa*, are more abundant in the western half of the range of *desertorum* than in the eastern half. The dark form, *comanche*, seems about equally abundant throughout. Hence over most of the range of *desertorum* all three color forms may exist in close proximity. Whatever these color variants are, they are not geographical races. I can see no reason why they merit formal names and have synonymized both with the typical *desertorum*.

24. Pheidole floridana Emery

Ph. flavens subsp. *floridana* Emery, Zool. Jahrb. Syst., Vol. 8, p. 293 (1895) ♀ ♎ ♀.
Type loc: Cocoanut Grove, Florida. Types: A.M.N.H., M.C.Z.
Range: known only from Florida, where it is by no means abundant.

25. Pheidole floridana lauta Wheeler

Ph. lauta Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 470 (1908) ♀ ♎ ♀ ♂.
Type loc: Comal River, New Braunfels, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: central Texas to Alabama.

The structural differences which separate *lauta* from *floridana* are very slight and consist mainly of a narrower and differently shaped head in the minor worker of the latter insect. There is no longer a wide gap separating the range of *lauta* from that of *floridana*. I have taken *lauta* in Alabama and I am reasonably certain that the record which Dr. M. R. Smith published for specimens of *floridana* taken at Ocean City, Mississippi also refers to this insect. There is no reason

why, at present, *lauta* may not be regarded as a western race of *floridana*. It will not be surprising if further study proves the two insects to be too closely related to permit even subspecific separation.

26. Pheidole grallipes Wheeler

Ph. grallipes Wheeler, Psyche, Vol. 23, p. 40 (1916) (*nomen nov.*).
Ph. susannae subsp. *longipes* Pergande, Proc. Calif. Acad. Sci. (2), Vol. 5, p. 885 (1895) ♀ ♁ (*nec* F. Smith).
Ph. longipes, Forel, Biol. Centrali. Amer. Hym., Vol. 3, p. 65 (1899); Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 397 (1915) ♀.
Type loc: Sierra San Lazaro, Mexico. Types: U.S.N.M.
Range: coastal region of southern California south into Lower California.

Although Mallis (1941) has reported a record for *grallipes* from Los Angeles County, all the other records for this species come from the San Diego area. The insect seems to do little more than barely get over the border into California and Mr. Mallis' record must certainly lie at the northern limit of the range.

27. Pheidole humeralis Wheeler

Ph. humeralis Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 456, pl. 27, fig. 39 (1908) ♀ ♁.
Type loc: Corsicana, Texas. Types: A.M.N.H., M.C.Z.
Range: known only from type material.

28. Pheidole hyatti Emery

Ph. hyatti Emery, Zool. Jahrb. Syst., Vol. 8, p. 295 (1895) ♀ ♁; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 456, pl. 27, fig. 32 (1908) ♀ ♁ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 558, pl. 7, fig. 26 (1947) ♁.
Ph. hyatti var. *ecitonodora* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 463 (1908) ♀ ♁.
Type loc: San Jacinto, California. Types: A.M.N.H.
Range: western Texas through southern New Mexico and Arizona to southern California.

The variety *ecitinodora* is so clearly a synonym of the typical form that it would seem scarcely worth mentioning were it not for one remarkable feature. Although *ecitinodora* is usually considered a color variety, it would seem to have actually been an odor variety. Wheeler believed that the soldiers of *ecitonodora* possess the 'rank fecal odor of

Eciton workers'. Wheeler may not have intended to imply that this form is primarily distinguished by odor but his choice of the name *ecitonodora* is hard to explain on any other basis. There is no significant color difference between *ecitonodora* and the insect which Wheeler regarded as the 'typical' *hyatti*. The color of *hyatti* varies considerably and the amount of variation in some nest series is greater than in others. What Wheeler did was to attribute the colonies with more constant color to the typical *hyatti* (hence his supposition that this form is rare) while the ordinary variable color pattern became the 'common form', the variety *ecitonodora*.

29. Pheidole hyatti solitanea Wheeler

Ph. hyatti subsp. *solitanea* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 409 (1915) ♀ ♂ ♀.

Type loc: Point Loma, San Diego, California. Types: M.C.Z., A.M.N.H.

Range: the coastal area in the San Diego region of California and probably south into Lower California.

The status of *solitanea* is at present problematical and will probably remain so until we know more of the ant fauna of Lower California. This subspecies differs from the typical *hyatti* mainly in having a smaller size in all three castes. The typical form often produces nests in which the majors are smaller than average but in such nests the sexual forms are of normal size. It happens that the present records for *solitanea* come from an area in which *hyatti* is also present. But it is possible that *solitanea* ranges south into Lower California and that the typical *hyatti* does not occur there. There are records of *hyatti* from Lower California but these seem to have been based on workers. It is, therefore, quite possible that these records should actually apply to *solitanea*.

30. Pheidole kingi instabilis Emery

Ph. kingi subsp. *instabilis* Emery, Bull. Soc. Ent. Fr., p. 120 (1901) ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 2, pl. 1, fig. 1–9 (1907) ♀ ♂ ♀ ♂; Wheeler, Ibidem, Vol. 24, p. 431 (1908) ♀ ♂ ♀ ♂; Wheeler, Ants, Columbia Univ. Press, p. 89, fig. 52 a–g (1910) ♀ ♂ ♀ ♂.

Type loc: Austin, Texas. Types: M.C.Z., Coll. W. S. Creighton.

Range: central Texas west to the Rio Grande and south into Mexico.

Ph. kingi possesses a strongly polymorphic worker caste. This fact was used by Forel as the basis for the establishment of the subgenus Allopheidole. Using *kingi* as the subgenotype, Forel built up a very

heterogeneous group in which the only common feature was the polymorphism of the worker. Wheeler attempted to better the matter by establishing another subgenus, Cardiopheidole, for *vasliti* and its variants. The only reason for the existence of Cardiopheidole is the fact that *vasliti* is not closely related to *kingi*. On this basis it would be necessary to establish a separate subgenus for each of the species which Forel placed in Allopheidole. Emery was clearly aware of the difficulties in which Forel and Wheeler had become embroiled and threw over both subgenera without hesitation. Emery's view is the only acceptable one for all the evidence indicates that polymorphism in the worker caste of Pheidole is not an index of subgeneric relationship but a trait that may appear in wholly unrelated species.

31. Pheidole kingi torpescens Wheeler

Ph. kingi subsp. *torpescens* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 404 (1915) ♀ ♎.

Type loc: Carnegie Desert Laboratory (near Tucson), Arizona. Types: M.C.Z.

Range: known only from type material.

32. Pheidole lamia Wheeler

Ph. lamia Wheeler, Amer. Naturalist, Vol. 35, p. 534, fig. 11 (1901) ♀ ♎; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 477, pl. 26, figs. 14–17 (1908) ♀ ♎.

Type loc: Austin, Texas. Types: A.M.N.H., M.C.Z.

Range: known only from type material.

33. Pheidole macclendoni Wheeler

Ph. macclendoni Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 450, pl. 27, fig. 36 (1908) ♀ ♎.

Type loc: Laredo and Corsicana, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: southern Texas to Arizona.

34. Pheidole marcidula Wheeler

Ph. marcidula Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 457(1908) ♀ ♎.

Type loc: Barton Creek, Austin, Texas. Types: A.M.N.H., M.C.Z.

Range: known only from type material.

35. Pheidole metallescens Emery

Ph. metallescens Emery, Zool. Jahrb. Syst., Vol. 8, p. 294 (1895) ♀.
Type loc: St. George, Florida. Types: none in this country.
Range: Gulf States, Florida to Texas.

The distinguishing feature of the typical form is the rather evenly sculptured head of the minor worker. This character is very constant in specimens coming from the eastern part of the range. The violaceous reflections in the minor worker are much less pronounced than those of the subspecies *splendidula* and some specimens show very little color.

36. Pheidole metallescens splendidula Wheeler

Ph. metallescens subsp. *splendidula* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 474, pl. 26, figs. 20, 21 (1908) ♀ ♁ ♀ ♂.
Type loc: Del Rio, Texas (by present restriction). Types: A.M.N.H., M.C.Z.
Range: southwestern Texas.

It appears imperative to restrict the type material of *splendidula* to those specimens from the southwestern part of the state. Much of the material which Wheeler used in the original description of this subspecies is plainly transitional to the typical form. This might have been expected, since some of the type series came from points as far east as Denton, Texas. It may be recalled that Wheeler commented on the variation in the type material of *splendidula*, which is not surprising for he was dealing, in part, with intergrades. The major range of *splendidula* probably lies in northeastern Mexico. In its typical form *splendidula* is easily distinguished from the eastern *metallescens* by the smooth and shining head of the minor worker. The violaceous reflections in this caste are also much more pronounced.

37. Pheidole militicida Wheeler

Ph. militicida Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 398(1915) ♀ ♁.
Type loc: Hereford and Benson, Arizona. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from southern Arizona.

38. Pheidole morrisi Forel

Ph. morrisi Forel, Ann. Soc. Ent. Belg., Vol. 30, C. R. p. 46 (1886) ♀ ♁; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 568 (1887) ♀ ♁; Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 350 (1901) ♀ ♁ ♀ ♂.
Ph. morrisi var. *vancae* Forel, Ibidem, p. 351 (1901) ♀ ♁ ♀ ♂.
Type loc: Vineland, New Jersey. Types: none in this country.
Range: southern New Jersey south to Florida and the eastern Gulf States.

It is impossible to recognize the validity of Forel's variety *vancae* because of the variability of the definitive characters on which that form was based. The principal differences are those of size and color and in neither case is the difference great. It is impossible to correlate such distinctions with distribution for *morrisi* shows such fluctuations over its entire range. In addition to the lack of spines on the epinotum, *morrisi* may be distinguished from *dentata* by its slightly longer antennal scapes and the more convex sides of the head in the major. The postpetiole of *morrisi* is less transverse than that of *dentata*.

39. Pheidole morrisi impexa Wheeler

Ph. morrisi var. *impexa* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 461, pl. 27, fig. 31 (1908) ♀ ♀♀ ♀ ♂.
Type loc: Del Valle, Austin, Texas. Types: A.M.N.H., M.C.Z.
Range: Texas and Oklahoma.

Wheeler regarded *impexa* as no more than a variety but it should be considered as a western race of *morrisi*. The insect is larger than the typical eastern form and has a much more abundant abdominal pilosity. The two forms will probably be found to intergrade in eastern Texas and Louisiana.

40. Pheidole nuculiceps Wheeler

Ph. nuculiceps Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 473(1908) ♀ ♀♀
Type loc: Comal River, New Braunfels, Texas. Types: M.C.Z.
Range: known only from type material.

41. Pheidole pilifera (Roger)

The revisionary changes proposed for the *pilifera* complex are rather extensive and it seems preferable to consider all of them in a single account. In the present volume this group of variants has been treated as follows:

Ph. pilifera Roger
= var. *simulans* Wheeler
= subsp. *septentrionalis* Wheeler
subsp. *artemisia* Cole
subsp. *coloradensis* Emery
= var. *neomexicana* Wheeler
subsp. *pacifica* Wheeler

The outstanding change is the inclusion of the subspecies *pacifica*, which has hitherto been related to *xerophila*. In my opinion, *pacifica* has much more in common with *pilifera* than with *xerophila*. The major worker of *pacifica* has strongly developed humeral angles, transverse striae on the occiput and a sharp crest on the petiolar node, all of which characters are present in *pilifera* but not in *xerophila*. The minor worker of *pacifica* is extensively sculptured, as in *pilifera*, and not smooth like the worker of *xerophila*. To these structural similarities may be added the fact that *pacifica* occurs in an area that cannot be considered exceptionally arid. In this respect it resembles *pilifera* rather than *xerophila*.

The remaining changes have to do with synonymy. In 1908 Wheeler presented a careful redescription of Emery's variety *coloradensis*. Wheeler pointed out the notable structural differences which separate this insect from the typical *pilifera* and proposed subspecific status for *coloradensis*. This proposal is entirely satisfactory but certain corollaries which accompanied it are not. At this same time Wheeler gave varietal status to a form which he called *simulans* and subspecific status to another, which he called *septentrionalis*. Wheeler contended that *simulans* is transitional in sculpture between the typical *pilifera* and the subspecies *coloradensis*. There is no reason why intergrading forms of this sort should not occur but the range of the material on which *simulans* was based removes any possibility that this insect is an intergrade between *pilifera* and *coloradensis*. All material belonging to *simulans* came from southern New York and New Jersey. The major portion of the range of *pilifera* lies to the west of this area and meets that of *coloradensis* in the prairie states. It seems absurd to contend that *simulans* is transitional between *pilifera* and *coloradensis*. The last place where one would look for such intergrades is along the Atlantic Seaboard. In the opinion of the writer *simulans* has nothing to do with *coloradensis* and represents one of the minor fluctuations of sculpture which occur in the eastern population of *pilifera*. The subspecies *septentrionalis* is equally suspect. There is little need to consider the sculptural distinctions cited by Wheeler for this subspecies, for they come within the range of variation shown by the typical *pilifera*. But Wheeler's statement that the head of *septentrionalis* is 'much shorter' than that of *pilifera* needs revision. Since I could see no obvious difference in the shape of the head in the two forms I made micrometer measurements of the heads of the major workers in the long series of cotypes on which *septentrionalis* was established. The heads of these specimens measure 1.6 mm. from the clypeal border to the top of the occipital lobes. The greatest width of the head is 1.5 mm. This supports Wheeler's contention that the head

of the major of *septentrionalis* is not much longer than broad, but it does not distinguish that form from the typical *pilifera*. Many of the specimens which Wheeler identified as the typical *pilifera* agree exactly with the measurements given above and, in those instances where the head of the major is larger, the same proportions hold. In my opinion *septentrionalis* cannot be defended, even as a nest variety. Its description seems due to a mistaken conviction that variation in size cannot occur in the major worker of the typical *pilifera*. In conclusion it may be added that the coexistence of *septentrionalis* and the typical *pilifera* in the same stations in the east shows that the former insect is not a subspecies.

The status of the variety *neomexicana* is better from a distributional standpoint, but it will not stand up to the definitive structural characters which are supposed to distinguish it. This variety was differentiated by its heavier sculpture, particularly that on the occipital lobes of the major, where transverse rugules occurred. These rugules were, supposedly, absent in the subspecies *coloradensis*. An examination of the type series of both variants has shown that each series contains both smooth and rugose individuals. Moreover, the writer has never seen a nest series in which both types of individuals did not occur. There seems to be no possibility that this variation can be explained on the basis of intergradation between two races. Since these fluctuations are shown by the entire population of *pilifera* which occurs in the southern Rockies, it must be assumed that this variability is inherent in the subspecies *coloradensis*, an assumption which is entirely in keeping with the comparable variability of the typical *pilifera*.

Cole's subspecies *artemisia* is known mainly from the type series, hence it is impossible to state how this form behaves. The types of *artemisia* are quite distinct from those of *coloradensis* and this same distinction applies to range. There is no reason, at present, to doubt the validity of *artemisia* as a Great Basin race of *pilifera*. There follows the synonymy of *Ph. pilifera* Roger:

Leptothorax pilifer Roger, Berl. Ent. Zeitschr., Vol. 7, p. 180 (1863) ♀.
Ph. pilifera Emery, Zool. Jahrb. Syst., Vol. 8, p. 290 (1895) ♀ ♎.
Ph. pilifera var. *simulans* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 436 (1908) ♀ ♎.
Ph. pilifera subsp. *septentrionalis* Wheeler, Ibidem, p. 436 (1908) ♀ ♎.
Ph. pennsylvanica Roger, Berl. Ent. Zeitschr., Vol. 7, p. 199 (1863) ♎; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 981 (1870); Mayr, Ibidem, Vol. 36, p. 455 (1886) ♀ ♎ ♀ ♂; Mayr, Ibidem, Vol. 37, p. 588 (1877) ♀ ♎.
Type loc: Pennsylvania. Types: none in this country.
Range: Massachusetts to North Carolina and west to Iowa and Nebraska.

42. Pheidole pilifera artemisia Cole

Ph. pilifera subsp. *artemisia* Cole, Ann. Ent. Soc. Amer., Vol. 26, No. 4, p. 616 (1933) ☿ ♁; Cole, Amer. Mid. Naturalist, Vol. 20, No. 2, p. 372 (1938) ♀.
Type loc: Provo, Utah. Types: Coll. A. C. Cole, Coll. C. H. Kennedy, Coll. W. S. Creighton.
Range: known only from Utah.

43. Pheidole pilifera coloradensis Emery

Ph. pilifera var. *coloradensis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 290 (1895) ☿ ♁.
Ph. pilifera subsp. *coloradensis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 434 (1908) ☿ ♁ ♀ ♂.
Ph. pilifera subsp. *coloradensis* var. *neomexicana* Wheeler, Ibidem, p. 436 (1908) ☿ ♁.
Type loc: West Cliff and Pueblo, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: northern New Mexico through Colorado to the Dakotas.

This insect prefers to nest in canyon bottoms and along the banks of streams. In Colorado it is most frequently encountered at elevations between 5000 and 6000 feet. It is more abundant on the eastern slopes of the Rockies than to the west of them. The colonies are generally larger than those of the typical eastern *pilifera*.

44. Pheidole pilifera pacifica Wheeler

Ph. xerophila subsp. *pacifica* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 404 (1915) ☿ ♁ ♀ ♂.
Type loc: Pasadena and Lakeside, California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.

45. Pheidole pinealis Wheeler

Ph. pinealis Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 459, pl. 27, fig. 38 (1908) ☿ ♁.
Type loc: Limpio Canyon, Ft. Davis, Texas. Types: A.M.N.H., M.C.Z.
Range: known only from type material.

46. Pheidole porcula Wheeler

Ph. crassicornis subsp. *porcula* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 466, pl. 27, fig. 35 (1908) ☿ ♁.
Type loc: Chisos Mountains, Texas. Types: A.M.N.H., M.C.Z.
Range: mountains in the Big Bend area in Texas north to Colorado. This insect undoubtedly occurs in the highlands of Chihuahua.

It may be recalled that Wheeler treated *porcula* as a subspecies rather than as a species because he felt that his variety *tetra* linked *porcula* to the typical *crassicornis*. There is little to support this view. As has been shown elsewhere, *tetra* is a western race of *crassicornis*. It intergrades with *crassicornis* but does not do so with *porcula*, although the range of *porcula* is coincidental with that of *tetra* over a large area in western Texas. It seems best, therefore, to regard *porcula* as specifically distinct from *crassicornis*. While the striking lateral expansion at the base of the antennal scape of the major is the outstanding characteristic of *porcula*, there are other differences which separate this insect from *crassicornis*. As Wheeler noted, *porcula* is larger, less hairy and more heavily sculptured than *crassicornis*. Its minor worker has the epinotum armed with denticles instead of the spines which are present in the minor of *crassicornis*.

47. Pheidole proserpina Wheeler

Ph. proserpina Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 437 (1908) ♀ ♎.
Type loc: Gila River, Tempe, Arizona. Types: A.M.N.H., M.C.Z.
Range: deserts of southern Arizona.

48. Pheidole ridicula Wheeler

Ph. ridicula Wheeler, Proc. New Eng. Zool. Club, Vol. 6, p. 29, figs. 1, a, b. (1916) ♎.
Type loc: Brownsville, Texas. Types: M.C.Z.
Range: known only from type material.

49. Pheidole sciophila Wheeler

Ph. sciophila Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 443, pl. 26, figs. 18, 19 (1908) ♀ ♎ ♀ ♂.
Type loc: Austin and New Braunfels, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: western Texas to southern Arizona.

50. Pheidole sciophila semilaevicephala M. R. Smith

Ph. sciophila subsp. *semilaevicephala* M. R. Smith, Ann. Ent. Soc Amer., Vol. 27, No. 3, p. 385 (1934) ♎.
Type loc: Yuma, Arizona. Types: Coll. M.R. Smith.
Range: deserts of southern Arizona.

51. Pheidole sitarches Wheeler

Ph. sitarches Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 440(1908) ♀ ♁ ♀.
Ph. sitarches var. *transvarians* Wheeler, Ibid., p. 442 (1908) ♀ ♁.
Type loc: New Braunfels, Texas (by present restriction). Types: A.M.N.H., M.C.Z.
Range: southern Texas.

I have restricted the type locality of *sitarches* to New Braunfels. As the following paragraph will show, material coming from the area around Austin is not dependable in the case of this species. It is unfortunate that Wheeler made extensive use of material coming from the Austin region without being aware of the reason for its variability. There are three races of *sitarches*. The typical *sitarches* is a southern race, *campestris* is a northern and eastern race and the western race is represented by the insect which Wheeler described as the species *soritis*. The northern end of the range of the typical *sitarches* overlaps the southwestern end of the range of *campestris* in the vicinity of Austin. In this area of overlap intergrades are produced in abundance. Wheeler was aware that the material from Austin varies considerably, for he commented on it. But Wheeler did not distinguish between the significant characters of the valid subspecies and the inconsequential ones of the intergrades. Instead he proposed names for both. His variety *transvarians* and his subspecies *rufescens* are intergrades. As might be expected, the type material of each of the above forms varies considerably. Many of the types of *rufescens*, for example, do not differ in any way from those of the typical *sitarches*. The latter form has been saved from a similar variability largely because a part of the type series came from New Braunfels. These specimens show a more constant structure and Wheeler was able to sort out specimens from the Austin area which correspond to them. The whole situation in regard to *sitarches* has been unfortunate. But at least it may serve to show the impossibility of analysing infraspecific variation when one is forced to deal with a circumscribed population. It is not until one leaves the area of intergradation around Austin that the true distributional characteristics of *sitarches* can be analysed.

52. Pheidole sitarches campestris Wheeler

Ph. sitarches subsp. *rufescens* var. *campestris* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 443 (1908) ♀ ♁.
Ph. sitarches subsp. *rufescens* Wheeler, Ibid., p. 443 (1908) ♀ ♁ ♀.
Type loc: Henrietta, Texas. Types: A.M.N.H., M.C.Z.
Range: central Texas northeast to Missouri and east to Mississippi.

I have chosen to retain the name *campestris* rather than *rufescens* for the northern race of *sitarches*. As has already been noted, the type series of *rufescens* is highly variable and does not show clearly those characters which distinguish this race. The types of *campestris*, on the other hand, agree well with material coming from a very large region which includes northeastern Texas and adjacent states. It is interesting to note that this population shows no such variation in structure as that which is characteristic of the Austin area. A number of records which have been attributed to *rufescens* belong, in my opinion, to *campestris*. Dr. Smith's records of *rufescens* from Oklahoma and Mississippi should be so considered.

53. Pheidole sitarches soritis Wheeler

Ph. soritis Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 439 (1908) ♀ ♎.
Type loc: Albuquerque, New Mexico. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: New Mexico and southern Utah.

I cannot agree with Wheeler that the node of the petiole in *soritis* differs notably in shape from that of *sitarches*. In *soritis* the crest of the node is slightly blunter and the impression at the middle of the crest is a little deeper but, except for these minor variations, the agreement seems remarkably good. I have never seen specimens of *soritis* in which the head of the major was as long as that which occurs in some of the soldiers of the typical *sitarches*. However, since majors with short heads also occur in the nests of the typical form, this is not a particularly significant difference.

54. Pheidole spadonia Wheeler

Ph. spadonia Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 400 (1915) ♀ ♎.
Type loc: Santa Cruz River, Tucson, Arizona. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: known from type material only.

55. Pheidole tepicana cavigenis Wheeler

Ph. tepicana subsp. *cavigenis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 403 (1915) ♎.
Type loc: Miller Canyon, Huachuca Mountains, Arizona. Types: M.C.Z.
Range: known from type material only.

56. Pheidole texana Wheeler

Ph. texana Wheeler, Psyche, Vol. 10, p. 97, fig. 4 (1903) ♀ ♎; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 464, pl. 27, figs. 33, 34 (1908) ♀ ♎.
Type loc: Travis County, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known from type material only.

57. Pheidole titanis Wheeler

Ph. titanis Wheeler, Psyche, Vol. 10, p. 95, fig. 3 (1903) ♀ ♎; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 461, pl. 27, fig. 30 (1908) ♀ ♎.
Type loc: Paisano Pass, Brewster County and Chisos Mountains, Texas. Types: A.M.N.H., M.C.Z.
Range: western Texas to southern Arizona.

58. Pheidole tysoni Forel

Ph. tysoni Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 349 (1901) ♀ ♎ ♂.
Type loc: Mt. Mitchell, North Carolina. Types: A.M.N.H.
Range: mountainous areas in western North Carolina, southwestern Virginia and eastern Tennessee.

59. Pheidole vallicola Wheeler

Ph. crassicornis subsp. *vallicola* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 409 (1915) ♀ ♎.
Type loc: Miller Canyon, Huachuca Mountains, Arizona. Types: M.C.Z., Coll. W. S. Creighton.
Range: mountains of southern Arizona.

There can be little doubt that *vallicola* is a separate species and not a subspecies of *crassicornis*. The antennal scapes of *vallicola* are longer than those of *crassicornis* in both major and minor. The occipital lobes of the major of *vallicola* are finely and densely granulose in addition to the coarse, oval punctures, with their surface subopaque. In *crassicornis* these parts are smooth and shining, with the only sculpture consisting of the coarse, scattered, oval punctures. The postpetiole of the *vallicola* major is notably less transverse and not much wider than the node of the petiole. The head of the minor of *vallicola* is evenly and densely granulose, like the thorax. In *crassicornis* the head of the minor is shining, with a few scattered punctures. Finally both *vallicola* and *crassicornis tetra* occur together in many parts of southern Arizona without showing the slightest indication of intergradation.

60. Pheidole vasliti arizonica Santschi

Ph. arizonica Santschi, Bull. Soc. Ent. Ital., Vol. 41, p. 3 (1909) ♀.
Ph. vasliti subsp. *subdentata* var. *arizonica* Wheeler, Jour. N. Y. Ent. Soc., Vol. 22, p. 50 (1914) ♀.
Type loc: Tucson, Arizona. Types: none in this country.
Range: mountains of southern Arizona.

61. Pheidole virago Wheeler

Ph. virago Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 401 (1915) ♀ ♀.
Type loc: Santa Cruz River, Tucson, Arizona. Types: M.C.Z., Coll. W. S. Creighton.
Range: known from type material only.

62. Pheidole xerophila Wheeler

Ph. xerophila Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 446, pl. 27, fig. 37 (1908) ♀ ♀ ♂.
Type loc: Ft. Davis, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from the Davis Mountains of western Texas.

63. Pheidole xerophila tucsonica Wheeler

Ph. xerophila subsp. *tucsonica* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 448 (1908) ♀ ♀.
Ph. xerophila subsp. *tucsonica* var. *gilvescens* Wheeler, Ibidem, p. 448 (1908) ♀ ♀.
Type loc: Tucson, Arizona. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: southern Arizona and the deserts of California.

Wheeler was of the opinion that *gilvescens* is an intergrade between the typical *xerophila* and the subspecies *tucsonica*. It certainly has every appearance of being so and it is curious that Wheeler should have felt it necessary to name this obviously transitional form.

Genus Epipheidole Wheeler

(Plate 22, figures 1–3)

The type material on which this genus was based came from three nests which Wheeler found near Colorado Springs. In each nest were soldiers and workers of *Pheidole pilifera* subsp. *coloradensis*. In addition to these, the first nest contained many males of Epipheidole and

three males of *coloradensis*. The second nest contained a single virgin female of Epipheidole. The third nest contained a fertile (deälated) female of Epipheidole and virgin females and males of that genus as well. Although Wheeler looked for them, he found no workers of Epipheidole. He therefore concluded that Epipheidole is a workerless parasite and that once it has secured entry into the nest of the host, *coloradensis*, the queen of the host species is dispatched by her own workers. The second part of this assumption is still problematical but it is now clear that Wheeler was not correct in assuming that *Epipheidole inquilina* is a workerless parasite. In 1941 Dr. M. R. Smith (*loc cit.*) announced the discovery of a single worker of this species and presented much pertinent data concerning the status of Epipheidole. Dr. Smith pointed out that, from a structural standpoint, Epipheidole and Pheidole are so closely related that it is impossible to arrive at any satisfactory criteria by which the two may be separated. It may be recalled that Emery, who first examined the female of Epipheidole, saw nothing inconsistent in treating the insect as a small queen of *coloradensis*. Wheeler was aware of this difficulty when he established Epipheidole but, since he believed it to be workerless, he could cite the absence of workers as a feature which separated Epipheidole from Pheidole. Now that Dr. Smith has shown that Epipheidole possesses workers, it is necessary to reconsider the status of this genus. Dr. Smith prefers to continue to recognize Epipheidole, since he believes that the workers are only rarely produced and that the soldier caste is entirely lacking. Since there seems to be no way at present of proving or disproving this contention, I have concurred with Dr. Smith's view and have retained generic status for Epipheidole. It seems certain, however, that we should be prepared for the eventual synonymization of Epipheidole with Pheidole. If *inquilina* can produce minor workers there is every reason to suppose that it can also produce majors. We may expect these to come to light in the future. There would then be no possible justification for separating Epipheidole from Pheidole and we would have to regard *inquilina* as a microgynous species in the latter genus. There is considerable justification for this view whether Epipheidole produces major workers or not. From what we know about other parasitic genera in the Formicidae, it seems hard to believe that Epipheidole would not show some structural features which would distinguish it from Pheidole if it were a valid genus.

For practical purposes the only thing that can be done with Epipheidole at present is to contrast it with its host, *Ph. pilifera coloradensis*. The male of *inquilina* is remarkably similar to that of *coloradensis*, from which it differs mainly in its smaller size (3–3.5 mm.).

The female of *inquilina* is also small (3–3.3 mm.) and of a peculiar, yellowish color. Its postpetiole is suboval, only slightly broader than long and with the lateral processes reduced to short angles. The female of *coloradensis* measures 7–8 mm., is dark brown in color and has a strongly transverse postpetiole which is much wider than long and possesses prominent lateral processes. The worker of *inquilina* differs from that of *coloradensis* in a number of minor details but possesses a clearly marked promesonotal suture which is indistinct or lacking in *coloradensis*. The epinotal spines in *inquilina* are thick, scarcely tapered and bluntly rounded at the tip. Those of *coloradensis* are slender, tapered and sharply pointed.

1. Epipheidole inquilina Wheeler

Epipheidole inquilina Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 15, pl. 2, figs. 12–17 (1904) ♀ ♂; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 42, No. 5, p. 106, fig. 1 (1940) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 558, pl. 7, fig. 27 (1947) ♀.

Type loc: female and male, Colorado Springs, Colorado.
worker, West Point? Nebraska.

Types: female and male, A.M.N.H., M.C.Z.
worker, U.S.N.M.

Range: eastern Colorado to Nebraska.

Host: *Ph. pilifera* subsp. *coloradensis*.

Genus Sympheidole Wheeler

(Plate 23, figures 1–4)

Virtually nothing is known about the habits or distribution of this genus which is represented by a single species, *elecebra*. The majority of the type series from which Sympheidole was described came from a nest taken by Wheeler near Manitou, Colorado. This nest contained a single deälated female and eighteen males of Sympheidole as well as soldiers and workers of the host, *Pheidole ceres*. In addition, Wheeler had a second female of Sympheidole, also associated with workers of *ceres*, which Schmitt had found near Boulder, Colorado. Because he found no female of *ceres* nor any workers of Sympheidole in either of these colonies, Wheeler postulated that Sympheidole is a workerless parasite with habits analogous to those of Anergates. Wheeler's premise may be correct but there is no way in which it can be verified until additional material is secured and the reactions of the living insects observed.

The males and females of Sympheidole are easily distinguished from the corresponding castes of the host species. The male of Sympheidole possesses a rounded and completely unarmed epinotum. The postpetiole, when seen from above, is strongly transverse with prominent, sharp, lateral connules. In the male of *Ph. ceres* the epinotum is strongly angular with the angle often thrown up at either side into a blunt projection resembling a very short, obtuse tooth. The postpetiole has the lateral connules reduced to low, angular processes. The most striking feature of the female of Sympheidole is its smooth and shining surface. The sculpture is much less extensive than that of the *ceres* female and on many parts of the body the sculpture consists only of scattered, piligerous punctures. In addition, the postpetiole of the Sympheidole female is almost four times as broad as long, with prominent, recurved, lateral projections. The postpetiole of the *ceres* female is proportionatley narrower and lacks the lateral processes.

1. Sympheidole elecebra Wheeler

S. elecebra Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 8, pl. 2, figs. 8–11 (1904) ♀ ♂; Wheeler, Ants, Columbia Univ. Press, p. 497, fig. 277A (1910) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 561 (1947) ♀.

Type loc: Manitou, Colorado. Types: A.M.N.H., M.C.Z.

Range: eastern Colorado.

Host: *Pheidole ceres.*

Genus Cardiocondyla Emery

In 1944 Dr. M. R. Smith presented a very thorough study of the four species of Cardiocondyla which have been taken in the United States. This contribution makes it much easier to handle these species, since it brings together in a single paper data which has previously been widely scattered throughout the literature. Dr. Smith discussed the distributional peculiarities of Cardiocondyla in some detail but he managed to avoid committing himself on the thorny problem as to whether any of these species can properly be considered as native ants. Since the species belonging to Cardiocondyla usually form small colonies and often nest in plant cavities as well as in soil, they are easily transported by commerce. A number of the species have now been so widely distributed by this means that it is often difficult to state exactly what region ought to be considered as

their native habitat. There would seem to be no doubt, however, that the genus is an Old World group. The great majority of the species are known from the warmer portions of Europe, Asia and Africa. It is significant that two of the forms known to occur in the United States have also been taken in various parts of the world. Since both these variants, *minutior* and *bimaculata*, belong to species which give every indication of having originated in southern Asia, there is little reason to suppose that either form is native to this country. Much the same considerations apply to *emeryi*. Although this species was originally described from material taken in the Virgin Islands, it has since been found to occur widely in Africa and the Malagasy region as well as in Asia Minor and India. *C. emeryi* has produced one race in the upper Nile valley and another in Madagascar, a circumstance which certainly seems to indicate an African rather than an Antillean origin. The writer can see no reason for doubting Emery's view that the type series of *emeryi* came from an area into which the insect had been introduced. It must be remembered, however, that *emeryi* occurs widely in the Antilles and it is probably from this region that it has been introduced into Florida. Wheeler's species *venustula* presents a much more difficult problem. This species was based on material coming from Culebra Island and Puerto Rico. It is also known from Mona Island and from Hayti. But aside from these Antillean records and a single record from Florida, there seem to be no others. It is impossible to relate *venustula* to any region in the Old World on the basis of our present knowledge, and it may be that this species has actually originated in the Antilles. It is easier to accept this possibility than to believe that *venustula* is a native of Florida. The few native species whose range includes both southern Florida and the Antilles invariably occur in Cuba or the Bahamas or both. It is not likely that *venustula* would have a range which skips from Puerto Rico and Hayti to southern Florida if the insect were native to the latter area. It seems to the writer that it is not only improper to regard *venustula* as a native species but it is highly doubtful if it ought to be considered as a member of our ant fauna on any grounds. The single record of *venustula* from Hollywood, Florida is not a proof of naturalization. I believe that we should be extremely cautious of drawing any conclusions from a single record of this sort. Several of our southern ports are subjected to a steady rain of introduced species which are brought in on the banana ships. I have often watched these ships unloading at Mobile, Alabama, and I feel quite certain that if one cared to do so it would be possible to compile a list of 'introduced species' for that port which would suggest the ant section of the *Biologia Centrali Americana*. Some of these species manage to

establish themselves in the vicinity of the docks, but they ordinarily do not survive the first bout with our winter climate. Records of this type of introduction may be of great interest to those concerned with pest control, but they seem out of place in a faunal study. However, since there is a good chance that *venustula* may be repeatedly brought into Florida and may even manage to establish itself there, I have included the species in this work.

Two features make the recognition of Cardiocondyla an easy matter. There is a total lack of erect hairs on all parts of the body and the postpetiole of the worker is dorso-ventrally flattened and at least twice as wide as the node of the petiole. A similar type of postpetiole is found in *Solenopsis globularia littoralis* but there is little possibility for confusion with this species because of the three-jointed antennal club and the armed epinotum in Cardiocondyla. In the key which follows, the main separatory characters employed are those which Dr. Smith presented in his 1944 key. I have, however, considerably simplified certain parts of Dr. Smith's key and have taken the liberty of presenting the separatory characters in a somewhat different order. In my opinion, the thoracic structure of *nuda minutior* separates it rather sharply from the other three species and I believe that it is preferable to bring this form out on the first lug of the key rather than on the last as was done in Dr. Smith's arrangement.

Key to the species of Cardiocondyla

1. Dorsum of the thorax, in profile, with the mesoepinotal suture unimpressed or at most very feebly impressed; the mesoepinotal suture usually obsolete on the thoracic dorsum ..... *nuda* subsp. *minutior*
   Dorsum of the thorax, in profile, with the mesoepinotal suture distinctly impressed; the mesoepinotal suture clearly marked on the thoracic dorsum..2
2. The antennal scapes failing to reach the occipital margin by an amount less than the greatest thickness of the scape; epinotum armed with a pair of very small denticles which are not spinose ..... *venustula*
   The antennal scapes failing to reach the occipital margin by an amount at least as great as the length of the first funicular joint; epinotum armed with a pair of spines 3
3. Node of the petiole, seen from above, longer than broad; the anterior border of the postpetiole straight or feebly convex when seen from above..*emeryi*
   Node of the petiole, seen from above, broader than long; the anterior border of the postpetiole distinctly concave when seen from above.....
   wroughtoni subsp. *bimaculata*

1. Cardiocondyla emeryi Forel

(Introduced)

C. emeryi Forel, Mitt. München Ent. Ver., Vol. 5, p. 5 (1881) ♀; E. André, Ann. Soc. Ent. Fr. (6), Vol. 1, p. 69, pl. 3, figs. 10–12 (1881) ♀ ♂; E. André, Spec. Hym. Europe, Vol. 2, p. 328, pl. 21, figs. 9–12 (1882) ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 128, pl. 11, fig. 6 (1908) ♀; Emery, Deutsche Ent. Zeitschr., p. 20, fig. 7 a, b, c (1909) ♀ ♂ (not ☿); Arnold, Ann. S. Afr. Mus., Vol. 14, p. 200, pl. 5, fig. 5, 7 (1916) ♀ ☿ ♂; Emery, Genera Insectorum, Fasc. 174, p. 124, pl. 2, fig. 20 (1922); M. R. Smith, Puerto Rico Univ. Jour. Agr., Vol. 20, p. 835, fig. 1 (1930) ♀; Borgmeier, Revist. Ent., Vol. 7, p. 133, figs. 1–5 (1937) ♂; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 46, No. 2, p. 33, pl. 5, fig. 1 (1944) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 558, pl. 7, fig. 28 (1947) ♀.

Type loc: St. Thomas, Virgin Islands. Types: none in this country.

Range: (in the United States) southern Florida.

2. Cardiocondyla nuda minutior Forel

(Introduced)

C. nuda var. *minutior* Forel, Fauna Hawaiensis, Formicid, p. 120 (1899) ♀; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 46, No. 2, p. 38, pl. 5, fig. 3 (1944) ♀.

Type loc: Honolulu and Molokai Territory, Hawaii. Types: none in this country.

Range: (in the United States) widely distributed in Florida as far north as Pensacola.

The validity of *minutior* seems strongly suspect. I have a series of specimens taken by Prof. E. G. Alexander in northern Siam which contains some workers referable to the typical *nuda* and others that are plainly *minutior*. As the typical form is widely distributed in the south Pacific it seems unlikely that *minutior* can be regarded as an Hawaiian endemic. I have given *minutior* subspecific rank but I suspect that further studies on this insect will show it to be a synonym of the typical *nuda*.

3. Cardiocondyla venustula Wheeler

(Introduced)

C. venustula Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 128, pl. 11, fig. 5 (1908) ♀ ☿; Wheeler and Mann, Ibidem, Vol. 33, p. 19 (1914) ☿; M. R. Smith, Puerto Rico Univ. Jour. Agr., Vol. 20, p. 836, fig. 2 (1936) ♀;

M. R. Smith, Proc. Ent. Soc. Wash., Vol. 46, No. 2, p. 37, pl. 5, fig. 4 (1944) ♀.
Type loc: Culebra Island and Coamo Springs, Puerto Rico. Types: M.C.Z., A.M.N.H.
Range: (in the United States) known only from southern Florida.

4. Cardiocondyla wroughtoni bimaculata Wheeler

(Introduced)

C. wroughtoni var. *bimaculata* Wheeler, Bull. Lab. Zool. Portici, Vol. 24, p. 43 (1929) ♀ ♀; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 46, No. 2, p. 40, pl. 5, fig. 2 (1944) ♀.
Type loc: Karashisho, Formosa. Types: M.C.Z.
Range: (in the United States) southern Florida.

In my opinion *bimaculata, obscurior* and *hawaiensis* are all the same insect. Wheeler set up the first two varieties on very minor color differences, some of which varied notably in the type series. I entirely agree with Dr. Smith that when the types of *hawaiensis* are better known it will probably be necessary to synonymize *bimaculata*. At the same time the form involved appears to be a valid race of *wroughtoni*, hence it may be given subspecific rank regardless of what name is applied to it.

Genus Crematogaster Lund

(Plate 24, figures 1–4)

At the present time the North American species of Crematogaster are badly in need of revisionary work. The literature which deals with this group is scattered, incomplete and often contradictory. Any attempt at revision, however, immediately runs afoul of the lack of type material in American museums. Not one of the numerous North American forms described by European myrmecologists is represented by type material in this country. This lack of types forces the use of descriptions. The substitution is make-shift at best and it is unlikely that a genus as complex as Crematogaster will yield to such a method of treatment. Yet, despite this depressing outlook, the student of Crematogaster in this country is better situated than his European predecessors. He enjoys the advantages of abundant material and a first-hand field knowledge of the species with which he is dealing. As Arnold has pointed out (1920), the use of field data is of paramount importance for evaluating variation in this genus.

Because of the unusual plasticity of many of the species, any analysis based solely on cabinet specimens is apt to lose itself in a maze of incomprehensible details. This is precisely what has occurred in the case of the *lineolata* complex. The species *lincolata* has been so burdened with infraspecific forms that it has become unmanageable. The studies which have brought about this condition have been drawn, in most cases, from small series of cabinet specimens. Emery, who is mainly responsible for the construction of the *lineolata* complex, lacked adequate field observations which might have led him to a more judicious conclusion. There is now good evidence that the complex consists of several species. A proposal to break it down into five species was made by Wheeler in 1919. As Wheeler's suggestion was not followed when Emery published the Myrmicine section of the *Genera Insectorum* in 1921, there has been confusion in regard to this matter. In the hope of clearing up this misunderstanding I have outlined the history of the *lineolata* complex.

The foundation for the complex was laid by Emery in 1895. In that year the second section of his *Beiträge* appeared and in that work Emery revised the North American representatives of Crematogaster. As a result of this revision Fitch's species *cerasi* and four of Mayr's species (*clara, coarctata, laeviuscula* and *opaca*) were made forms of *lineolata.* At the same time Emery described five additional variants (*californica, lutescens, pilosa, mormonum* and *subopaca*) which he assigned to *lineolata.* Thus in 1895, according to Emery's view, *lineolata* was represented by ten infraspecific forms. The immediately ensuing years altered this concept only to provide more variants. In 1908 Wheeler added a new form, *depilis,* and reduced Emery's species *punctulata* to varietal status under *lineolata.* No further change was made until 1919, when Wheeler published a list in which *lineolata* was broken down into five species (*lincolata, coarctata, laeviuscula, opaca* and *pilosa*). Beyond stating that his proposal was "merely a return to the position of Mayr", Wheeler gave no reasons for the change. This was unfortunate, for it made acceptance largely a matter of faith. Had supporting data been presented there would have been less likelihood for the erroneous impression that Emery later refused to accept Wheeler's stand. It is easy to get this impression from Emery's treatment of the *lineolata* complex in the *Genera Insectorum.* The fact is that Emery was unaware of Wheeler's suggestion. The paper which carried Wheeler's revisionary proposal also contained the description of a new species, *atkinsoni.* This species is not included in the *Genera Insectorum,* hence it seems certain that Emery had not seen Wheeler's revisionary paper.

It is necessary to consider the 'survey' of the New World species

of the subgenus Acrocoelia which was published under the name of Jane Enzmann in 1946. This revision is largely based on Wheeler's 1919 list but it embodies other changes and includes the Antillean and Neotropical representatives of Acrocoelia which Wheeler's list omitted. It is somewhat disconcerting to discover that Enzmann has made no attempt to present reasons for the revisionary changes proposed in this paper. The only evidence which could be adduced in this regard would seem to lie in the key which forms a very considerable part of the publication. There are many highly remarkable points about this key. It is prefaced by the following statement:

"In some cases the original description does not fit the specimens studied accurately; the key was therefore made synoptic and was based on both, specimens and description."

If this extraordinary statement is to be taken at its face value it must mean that some of the separatory characters in Enzmann's key represent a compromise between the original description and specimens which do not fit that description but which Enzmann, nevertheless, accepted as representatives of the form in question. Perhaps this was actually done in certain cases but what seems more likely is that, whenever Enzmann was confronted with this difficulty, the dichotomous arrangement of the key was abandoned and the 'synoptic' sections which it embodies were employed. Since these 'synoptic' sections are not given a dichotomous treatment, the forms included in them need not be brought out on contrasting characters. As a result, forms which are not clearly separable have been given a spurious distinction by this peculiar method of treatment. But this is by no means the only bad feature of the key. Twenty of its twenty-eight dichotomous couplets are so constructed that they can be used only if members on both sides of the split are available for comparison. The differences cited are of the 'more–less' sort and this practice is consistently followed even when there are excellent positive distinctions available. In addition, far too much reliance has been placed upon slight differences of color, a trait which has singularly little taxonomic significance in this group. I have found Enzmann's key to be largely without value because of the defects mentioned above. Perhaps the best indication of its altogether unreliable character is the fact that it contains the species *kennedyi* and *creightoni*. Both these insects are known only from the sexual forms and both are believed to be workerless parasites. Hence it is impossible to deal with them successfully in a key which is based on worker characteristics. It seems best to regard Enzmann's revisionary proposals as unsupported statements which do not merit serious consideration. No attempt has been made to deal with them in this publication.

The situation in regard to the new variants of Acrocoelia described by Enzmann is even more depressing. An incredibly inept treatment has obscured the authorship, source, specific relationship and structural character of the variety called *coachellai*. It is impossible to determine from Enzmann's paper what this form is or to be certain of where it was taken. The two varieties of *lineolata* (*wheldeni* and *punctinodis*) which were described as new are probably synonyms of the typical *lineolata*. They have been treated as such in the present work.

Most of our species of Crematogaster nest under stones, in logs or in standing timber, where decay enables them to tunnel in the wood or beneath the bark. Many of the species tend aphids and will build carton sheds to cover them. Similar carton containers are often made by *lineolata* and used as brood chambers. Such incubators may be several yards away from the main nest. I believe that the pendant, carton nests of *atkinsoni* serve the same purpose. In 1919 Wheeler expressed the opinion that this habit of *atkinsoni* was an adaptation to a marshy type of habitat which made it impractical for the insect to nest in the soil. This theory would be more acceptable if *atkinsoni* always occurred in palustrine areas. According to my observations it rarely does so. This ant is abundant in many parts of Alabama. It usually nests in soil or logs but, on occasion, it builds pendant, carton chambers into which the entire colony may move. My observations on *atkinsoni* have been made only during the summer months and so I cannot be sure that their residence in the carton is a temporary one. This is certainly true in the case of *lineolata*, which abandons its carton brood chambers at the beginning of the fall. Another interesting example of flexibility in nesting habits is found in the case of *laeviuscula*. This insect frequently starts its nests in live-oak galls. When the size of the colony has reached a point where there is not enough space in the gall, the nest is moved to more spacious quarters in a rotten log.

Before presenting the key to our North American species of Crematogaster, I wish to discuss the status of two species which do not appear in the key. These are the supposedly parasitic species *kennedyi* and *creightoni*. The first species is based upon males and females taken in a nest of *lineolata*. The second was described from females which were secured in a nest of *pilosa*. The most conspicuous characteristic of both these species is their small size. This and other considerations led Wheeler to regard them as workerless parasites. This supposition may be correct but it should be borne in mind that in each case winged females of the "host "species were present. The conclusion is inescapable that the queen of the "host" species was still present and functional. While her presence does not disprove Wheeler's

contention, it permits another explanation. The small females of *kennedyi* and *creightoni* may be the "beta forms" of a dimorphic female caste. The writer is inclined to favor this view. The structural differences which distinguish these small females from the "host" species are very slight. Furthermore, the female of *creightoni* possesses the abundant, erect, tibial hairs which are so characteristic of *pilosa*. It is probable that future field observations will make it necessary to synonymize *kennedyi* with *lineolata* and *creightoni* with *pilosa*.

Key to the species of Crematogaster

1. Postpetiole suboval and entire, without a trace of a median sulcus (subgenus *Orthocrema*) 2
   Postpetiole divided by a distinct median sulcus (subgenus *Acrocoelia*) .. 5
2. Tip of the antennal scape in repose notably surpassing the occipital border; color yellow; the gaster clothed with abundant long hairs 3
   Tip of the antennal scape in repose failing to reach the occipital border; color piceous brown; the erect hairs of the gaster short and sparse ..... *arizonensis*
3. Dorsum of the promesonotum very smooth and shining; rugae, if present, feeble and confined to the edge of the pronotum ..... *minutissima* subsp. *smithi*
   Dorsum of the promesonotum finely punctate in addition to the longitudinal rugae, the surface feebly shining; rugae well developed and often placed toward the center of the promesonotum 4
4. Epinotal spines about one-half as long as the distance which separates their bases and directed upward; pronotum with the rugae usually lateral in position ..... *minutissima* subsp. *missouriensis*
   Epinotal spines less than half as long as the distance which separates their bases and directed more backward than upward; pronotum with two prominent rugae near the middle ..... *minutissima*
5. Tibiae with numerous completely erect hairs on all surfaces; body hairs fine, erect and very abundant, particularly on the gaster where they are evenly spaced and form a thin investiture ..... *pilosa*
   Tibial hairs, when present, appressed over most of the surface, the only erect hairs on the tibiae being a small cluster immediately behind the spurs; body hairs, when present, never more than moderately abundant; erect gastric hairs coarse, widely spaced and not forming an investiture .. 6
6. Thoracic dorsum without erect hairs or with not more than eight erect hairs which are confined to the humeral angles of the pronotum (rarely with three or four very short hairs arising from the mesoepinotal suture in addition to the hairs at the humeral angles) 10
   Thoracic dorsum with at least fifteen erect hairs which are scattered over the entire promesonotum 7
7. Most of the upper surface of the head covered with distinct, close-set punctures, the surface opaque ..... *opaca*

The posterior half of the head moderately to strongly shining, the surface smooth, shagreened or moderately punctate but never so densely sculptured as to be completely opaque 8

8. Epinotal spines long and strongly diverging; promesonotum feebly sculptured and moderately shining ..... *atkinsoni*
Epinotal spines of moderate length, parallel or at most slightly diverging; promesonotum heavily sculptured, opaque or subopaque 9

9. Epinotal spines slightly divergent, their tips suddenly narrowed and often deflected outward more strongly than the rest of the spine; color usually dirty yellow ..... *lineolata* subsp. *subopaca*
Epinotal spines parallel or nearly so, evenly tapered from base to tip with the tips never turned outward; color usually castaneous brown ..... *lineolata* subsp. *punctulata*

10. Antennal scape in all sizes of the worker surpassing the occipital border by an amount equal to or greater than the length of the first funicular joint ..... *mormonum*
Antennal scape not surpassing the occipital border or surpassing the occipital border by an amount less than the length of the first funicular joint (the minims of those species having a worker caste which varies strongly in size may have a scape as long as that of *mormonum*) 11

11. Epinotal spines very short and suddenly thickened at the base; length not exceeding 3 mm., usually less ..... *ashmeadi*
Epinotal spines not as above; length usually exceeding 3 mm. 12

12. Size strongly variable (3–5 mm.); head of the largest worker at least one-fourth broader than long with the occiput distinctly concave in the middle; epinotal spines long and strongly divergent; sculpture feeble; head and thorax clear orange yellow, the gaster brown with a yellow patch at the base of the first segment ..... *laeviuscula*
Not combining all the above characters 13

13. Dorsum of the thorax completely devoid of erect hairs; promesonotum densely punctate, the punctures largely or completely replacing the rugae except for a few short ones at the anterior edge of the pronotum ..... *depilis*
Dorsum of the thorax with at least one long, erect hair at each humeral angle; promesonotum not densely punctate or if densely punctate the punctures do not obscure the rugae which run completely across the promesonotum 14

14. Thorax with two or three erect hairs at each humeral angle; rugae on the dorsum of the promesonotum delicate, the interrugal punctures feeble, the surface somewhat shining 15
Thorax with one long, erect hair at each humeral angle; rugae on the dorsum of the promesonotum coarse and vermiculate, the interrugal punctures prominent, the surface opaque ..... *coarctata* subsp. *vermiculata*

15. Posterior half of the head smooth and shining with small, scattered punctures or finely shagreened 16
Posterior half of the head covered with shallow, confluent punctures which give it the appearance of being crossed by delicate, longitudinal striae .. *coarctata*

16. Epinotal spines long and divergent with the tips usually bent outward; rugae of the promesonotum delicate, scarcely distinct from the interrugal sculpture ..... *lineolata*
Epinotal spines of moderate length and scarcely divergent, their tips not bent outward; rugae of the promesonotum distinct .....
lineolata subsp. *emeryana*

Subgenus ORTHOCREMA Santschi

1. CREMATOGASTER (ORTHOCREMA) ARIZONENSIS Wheeler

Cr. arizonensis Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 482, pl. 27, fig. 40 (1908) ♀; Creighton, Psyche, Vol. 46, No. 4, p. 139 (1939) ♀.
Type loc: Tucson and Phoenix, Arizona. Types: A.M.N.H., M.C.Z.
Range: mountains of southern Arizona. This species undoubtedly ranges into Mexico, although as yet there seem to be no Mexican records for it.

2. CREMATOGASTER (ORTHOCREMA) MINUTISSIMA Mayr

Cr. minutissima Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 991 (1870) ♀ ♀; Creighton, Psyche, Vol. 46, No. 4, p. 139 (1939) ♀.
Type loc: Texas. Types: none in this country.
Range: South Carolina to Florida and westward through the Gulf States to Texas.

3. CREMATOGASTER (ORTHOCREMA) MINUTISSIMA SMITHI (new name)

Cr. (*O.*) *minutissima* subsp. *thoracica* Creighton, Psyche, Vol. 46, No. 4, p. 138 (1939) ♀ (*nec* Santschi).
Type loc: Huachuca Mountains, Arizona. Type: M.C.Z.
Paratypes: Coll. W. S. Creighton.
Range: known only from the Huachuca Mountains of Arizona.

Dr. M. R. Smith has recently called my attention to the fact that my name *thoracica* is preoccupied. In 1921 Santschi used this name for a form of Crematogaster taken in the Belgian Congo, (Ann. Soc. Ent. Belg., Vol. 61, p. 118, 1921). I have, therefore, replaced my homonymic name *thoracica* with the name *smithi*.

4. CREMATOGASTER (ORTHOCREMA) MINUTISSIMA MISSOURIENSIS Emery

Cr. victima subsp. *missouriensis* Emery, Zool. Jahrb. Syst., Vol. 8, p. 288 (1895) ♀.
Cr. (*O.*) *minutissima* subsp. *missouriensis* Creighton, Psyche, Vol. 46, No. 4,

p. 139 (1939) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 558, pl. 7, fig. 29 (1947) ♀.

Type loc: Missouri. Types: probably none in this country (see below).
Range: Texas to Missouri.

In a recent paper I have shown that *missouriensis* must be regarded as a subspecies of *minutissima*. It was formerly treated as a subspecies of the South American *victima*. It is unlikely that there are any cotypes of *missouriensis* in this country. Although there are specimens so labeled in the M.C.Z. and A.M.N.H. collections, I believe that these are a part of the original series retained by Pergande and, while authentic, they are probably not cotypes.

Subgenus Acrocoelia Mayr

5. Crematogaster (Acrocoelia) ashmeadi Mayr

Cr. ashmeadi Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 463 (1886) ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 8, p. 286 (1895) ♀.

Cr. atkinsoni var. *helveola* Wheeler, Psyche, Vol. 26, No. 4, p. 110 (1919) ♀ ♂ (not the ♀).

Cr. (*A.*) *ashmeadi* var. *matura* Wheeler, Jour. N. Y. Ent. Soc., Vol. 40, p. 8 (1932) ♀.

Type loc: Florida (by present restriction). Types: none in this country.
Range: Atlantic Coast States from Virginia to Florida and the eastern Gulf States.

An unfortunate and peculiar mix-up has involved this species with the variety *helveola*. When Wheeler assigned *helveola* to *atkinsoni* he must have been unaware that the type series of *helveola* is mixed. As far as the workers are concerned both *ashmeadi* and *atkinsoni* are represented. The male and female which Wheeler described as belonging to *helveola* actually belong to *ashmeadi*. I have frequently taken both *ashmeadi* and *atkinsoni* in Alabama and the sexual forms of the two species are too distinct to allow any possibility for mistaking their specific relationships. The female of *ashmeadi* is (as Wheeler noted when he described it as *helveola*) a small insect measuring about 6 mm. in length. Its head is as long as broad with the sides feebly convex and not notably narrowed in front of the eyes. The antennal scapes fail to reach the occipital margin. The occipital angles are covered with appressed hairs. In contrast the female of *atkinsoni* measures 8.5–9 mm. in length. Its head is notably broader than long and distinctly narrowed in front of the eyes. The

antennal scapes slightly surpass the occipital margin and the occipital angles bear numerous, short, erect hairs. It is to be hoped that the above explanation will clear up Wheeler's unfortunate error. It is regrettable that the circumstance should have confused *ashmeadi* and *atkinsoni* for the two species are actually very distinct.

The variety *matura*, described by Wheeler in 1932, is, in my opinion, without validity. This insect was secured in an area where the typical form abounds (Miami, Florida). Three of the four characters which were given as its diagnostics (color, sculpture and spine length) are variable in the typical *ashmeadi*. Most nests of the typical *ashmeadi* contain some individuals which could be referred to *matura*. It would be difficult to defend this form even as a nest variety. That it represents a subspecies is out of the question. I have synonymized *matura* with *ashmeadi*.

6. Crematogaster (Acrocoelia) atkinsoni Wheeler

Cr. atkinsoni Wheeler, Psyche, Vol. 26, No. 4, p. 109, fig. 1 b (1919) ♀.
Cr. atkinsoni var. *helveola* Wheeler, Ibidem, p. 109 (1919) ♀ (not the ♀♂).
Type loc: Ft. Myers, Florida. Cotypes: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: Florida, southern Georgia and the eastern Gulf States. A single record of this insect from Belmont, N. C. lies well to the north of the main range.

Wheeler's variety *helveola* was founded on a mixed type series in which the sexual forms and some of the workers are *ashmeadi* (see above). The remaining workers which do belong to *atkinsoni* are not significantly different from the typical form. The only distinction which marks them is a lighter coloration. As such pale individuals occur in various parts of the range of *atkinsoni*, it is not possible to consider *helveola* as a subspecies. I have synonymized it with *atkinsoni*. The nesting habits of *atkinsoni* have been discussed in the introductory paragraphs dealing with the genus Crematogaster.

7. Crematogaster (Acrocoelia) coarctata Mayr

Cr. coarctata Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 990 (1870) ♀.
Cr. lineolata subsp. *coarctata* Emery, Zool. Jahrb. Syst., Vol. 8, p. 283 (1895) ♀.
Cr. lineolata subsp. *laeviuscula* var. *californica* Emery, Ibid., p. 285 (1895) ♀.
Type loc: San Mateo and San Francisco, California. Types: none in this country.
Range: California, San Francisco south to Los Angeles.

In the present work I have treated *vermiculata* as a subspecies of *coarctata*. While this interpretation will not cover all the known variability in the case of these two insects (see below) it recognizes the fact that there is too much intergradation to permit *vermiculata* to have specific status. Both *coarctata* and *vermiculata* were described from inadequate series (two workers in the case of *vermiculata*) and this has given a false value to the differences which are supposed to separate them. The typical *coarctata* is an easily recognized insect. The head is almost completely covered with confluent punctures which give the surface a finely striate appearance. The antennal scape distinctly surpasses the occipital margin. The pronotum is decidedly quadrangular in the larger specimens with the humeral angles well marked. The epinotal spines are distinctly divergent. The dorsum of the pronotum is feebly shining with the rugae fine and not particularly wavy and the interrugal punctures weak. The color is piceous brown. This is the form which occurs in the north central part of California, particularly in the San Francisco area. It appears to be the only representative of the genus which occurs as far north as San Francisco.

The characteristics of the typical *vermiculata* are quite distinct from those of *coarctata*. In *vermiculata* the posterior half of the head is smooth and shining with the only sculpture consisting of very fine punctures. The antennal scape barely surpasses the occipital margin. The pronotum is evenly rounded in front. The epinotal spines are feebly divergent. The dorsum of the thorax is completely opaque and covered with coarse, vermiculate rugae and heavy punctures. The head and thorax are orange with the gaster brown. This insect has a range which begins in the Los Angeles area and runs eastward into Arizona. In the eastern part of this range the structure of *vermiculata* is quite constant. But in the California coastal area from Santa Barbara to San Diego there is a flourishing population of intergrades between *vermiculata* and the typical *coarctata*. Emery's variety *californica* is obviously one of these intergrades. But it is not possible to explain all the forms which occur in southern California on the assumption that they connect *coarctata* and *vermiculata*. Some of them are more extreme in certain characters than either of the above races. I feel sure that the explanation for this lies in the presence of a third, unrecognized subspecies in Lower California. When this area is better known we may secure the information which is needed to clear up the confusing situation which at present marks *coarctata* in southern California.

8. Crematogaster (Acrocoelia) coarctata vermiculata Emery

Cr. vermiculata Emery, Zool. Jahrb. Syst., Vol. 8, p. 286 (1895) ♀.
Type loc: Los Angeles, California. Types: none in this country.
Range: southern California eastward into Arizona.

9. Crematogaster (Acrocoelia) creightoni Wheeler

Cr. (*A.*) *creightoni* Wheeler, Psyche, Vol. 40, No. 2, p. 86 (1933) ♀.
Type loc: Roanoke, Virginia. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: known only from type material.

10. Crematogaster (Acrocoelia) depilis Wheeler

Cr. lineolata subsp. *opaca* var. *depilis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 478 (1908) ♀.
Type loc: Cerro Carrigal, Mexico. Types: A.M.N.H., M.C.Z.
Range: southwestern Texas to southern Arizona. This species enters the United States at various points along our southern border. Its main range lies in Mexico.

Wheeler was not inclined to attach much significance to *depilis*, which he believed to be an intergrade between *punctulata* and *opaca*. In my opinion *depilis* is clearly a separate species and I am unable to understand the reason why Wheeler considered it related to either of the above forms. It is much less hairy than either of them and the cephalic sculpture is also less pronounced. The female of *depilis* is a large insect measuring 9.5–10 mm. It has a head which is notably quadrate, slightly broader than long and with the sides not converging in front of the eyes. The antennal scapes barely reach the occipital margin. The under surface of the head is densely and evenly clothed with long, delicate, erect hairs. This insect is distinct from the females belonging to the members of the *lineolata* complex. As the female of *opaca* is unknown, a comparison with that species is at present impossible.

11. Crematogaster (Acrocoelia) kennedyi Wheeler

Cr. (*A.*) *kennedyi* Wheeler, Psyche, Vol. 37, No. 1, p. 58 (1930) ♀ ♂.
Type loc: Robinson Park, Ft. Wayne, Indiana. Types: M.C.Z., A.M.N.H., Coll. C. H. Kennedy.
Range: known only from type material.

12. Crematogaster (Acrocoelia) laeviuscula Mayr

Cr. laeviuscula Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 993 (1870) ♀.
Cr. lineolata subsp. *laeviuscula* Emery, Zool. Jahrb. Syst., Vol. 8, p. 284 (1895) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist.,Vol. 24, p. 480 (1908) ♀ ♀.
Cr. (*A.*) *laeviuscula* Wheeler, Psyche, Vol. 24, No. 4, p. 111 (1919).
Cr. clara Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 993 (1870) ♀.
Cr. lineolata subsp. *laeviuscula* var. *clara* Emery, Zool. Jahrb. Syst., Vol. 8, p. 285 (1895); Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 481 (1908).
Cr. laeviuscula var. *clara* Wheeler, Psyche, Vol. 24, No. 4, p. 111 (1919); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 564, pl. 8, fig. 30 (1947) ♀.
Type loc: Ft. Cobb, Texas. Types: none in this country.
Range: Oklahoma southwestward through Texas, southern New Mexico and Arizona into Mexico. Emery's record of this insect from Indiana is certainly erroneous.

In 1908 Wheeler published data which showed that Mayr's *laeviuscula* is a minim from an incipient nest of *clara*. Wheeler's evidence for this conclusion is incontrovertible. He had taken both forms in live-oak galls at various stations in central Texas. Not infrequently both forms were found living in different galls on the same tree. Wheeler pointed out that the large workers with the characteristics of *clara* were always found in populous colonies, while the small workers with the characteristics of *laeviuscula* invariably came from incipient nests. Most significant of all, Wheeler showed that, despite the notable size difference of *laeviuscula* and *clara*, the sexual forms of the two were indistinguishable. There can be no question concerning Wheeler's findings. They may be checked on any large series of workers belonging to this species. Minims may not always be present but the smaller the workers are, the more closely they approach the conditions of *laeviuscula*. I have two such series of workers taken by Dr. P. J. Darlington at Brownsville, Texas. The large workers show all the characteristics of *clara*, the smallest workers those of *laeviuscula*. It is not clear why Wheeler failed to make the synonymy which his observations demanded, but it is clear that, under such circumstances, the continued use of both names is little short of ridiculous. Since *laeviuscula* has page precedence, the name *clara* must go into the synonymy.

13. Crematogaster (Acrocoelia) lineolata (Say)

In the past the species *lineolata* has been subject to such widely different taxonomic treatments that it seems advisable to preface the synonymy of this species with a discussion of some of the difficulties

which these divergent views have brought about. I have already referred, in the introductory paragraphs dealing with the genus Crematogaster, to the diverse views held by Wheeler and Emery as to the constitution of *lineolata*. While I propose to follow Wheeler in splitting up the *lineolata* complex into several species, this is only a partial solution to the problem. After all the valid species have been removed there still remains a residue of forms which must be dealt with. It is these residual forms which I wish to consider in the following paragraphs.

Much of the difficulty connected with the *lineolata* complex has resulted from the absence of Say's types. Had these been available for examination, Say's rather sketchy original description could have been augmented with the details which have since been found necessary. These details have been supplied but their accuracy is suspect. For subsequent descriptions of the 'typical' *lineolata* have been based on material which Say could not have seen at the time when he described *lineolata*. Say's description may have been brief but it was based on specimens taken in Indiana. One would have expected that subsequent investigators would have drawn their redescriptions of *lineolata* from material coming from this general region. No doubt they would have done so if such specimens had been available but, as this was not the case, they used what they had. Thus the two most important of these redescriptions (Mayr 1886, Emery 1895) were composites based upon material from several areas, none of which were anywhere near Indiana. Emery, for example, utilized specimens from Virginia and Florida in drawing up his description of the 'typical *lineolata*'. Since the form of this insect which occurs in Indiana does not occur in Florida, it seems certain that Emery's association was incorrect.

A second difficulty has to do with Fitch's *cerasi*. This insect was unrecognizable until 1886, at which time Pergande sent named specimens to Mayr and Emery. As some of Fitch's types are present in the collection of the National Museum, it is possible that Pergande had compared his specimens with the types of *cerasi*. Neither Mayr nor Emery questioned Pergande's identification. Mayr contented himself with a brief note to the effect that Pergande's specimens 'belonged to *lineolata*'. Emery was less cautious. He compared *cerasi* with his 'typical *lineolata*', of which he regarded *cerasi* as a variety, and gave differences by which the two could be separated. As has been shown, Emery's 'typical *lineolata*' was almost certainly not the same as Say's insect. Thus Emery's comparison meant little, since he had no clear concept of the nature of the typical form. Yet this comparison has been the basis for the subsequent recognition of *cerasi* which, on

Emery's statement, is held to be a pale variety of *lineolata*. This statement has been reversed to make the typical *lineolata* a dark-colored insect, a view which can scarcely be supported by field observations.

The examination of a very large amount of material coming from the northeastern United States has convinced the writer that color distinctions are without taxonomic significance in the case of *lineolata*. It is only in the extreme western portion of its range that the typical *lineolata* appears to show any notable constancy in this respect. The western specimens appear to be uniformly pale, but over most of its range *lineolata* shows wide variations in color. It is certain that these color fluctuations have no geographical connection. They occur at random and not infrequently appear in closely adjacent nests in the same area. There is good indication that they represent a response to local environmental conditions such as temperature and moisture. For this reason Emery's attempt to attach names to these color variants seems to have been ill-advised.

While the varieties *cerasi* and *lutescens* cannot be regarded as geographical races, there are other variants related to *lineolata* which can. It may simplify what follows to outline the range of the typical *lineolata*, since it is more extensive than that of any of the other subspecies. The range of the typical *lineolata* begins in southern New Brunswick and runs southwestward through New England, southern Ontario and the North Central States. It ultimately reaches eastern Colorado, but the insect is decidedly rare in that region. In the east the main range of the typical *lineolata* apparently terminates at about the latitude of Virginia, but there are extensions which run southwards at higher elevations in the Appalachian Highlands as far as northern Georgia. The subspecies *subopaca* has a range which overlaps that of the typical form in a large area extending from southern New England south to Virginia and west in the region which lies immediately to the south of the Great Lakes. In this area of overlap many intergrades are produced. But the major range of *subopaca* occurs from the South Atlantic States westward to southern Colorado, New Mexico and Texas. Over most of this region the only subspecies present is *subopaca* and in the southern states an elevational difference keeps *subopaca* and the typical *lineolata* separated, since the former is a low-level subspecies. At the western end of its range *subopaca* comes in contact with the subspecies *punctulata*. Intergrades between the two subspecies occur in western Texas, New Mexico, Colorado and Kansas. One of these intergrades has been described by Santschi as the variety *texana*. The fourth subspecies belonging to this complex has never been named although Emery described it in 1895. It occurs at moderate elevations in Colorado, New Mexico and Arizona and intergrades with *punctulata* in the eastern part of New Mexico.

As a result of the considerations just discussed I would arrange the *lineolata* complex as follows:

Cr. (*A*) *lineolata* (Say)
= var. *cerasi* Fitch
= var. *lutescens* Emery
= var. *punctinodis* Enzmann
= var. *wheldeni* Enzmann
subsp. *subopaca* Emery
subsp. *punctulata* Emery
= var. *texana* Santschi
subsp. *emeryana* (new name)

There follows the synonymy of *Cr.* (*Acrocoelia*) *lineolata* (Say):

Myrmica lineolata Say, Bost. Jour. Nat. Hist., Vol. 1, p. 290 (1836) ♀ ♀ ♂.
Cr. lineolata Roger, Verz. Formicid., p. 37 (1863); Mayr, Verh. Zool-bot. Ges. Wien, Vol. 16, p. 901, pl. 20, fig. 11 (1866) ♀; Mayr, Ibid., Vol. 20, p. 990 (1870); Mayr, Ibid., Vol. 36, p. 462 (1886) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 280 (1895) ♀.
Myrmica cerasi Fitch, Trans. N. Y. State Agri. Soc., Vol. 14, p. 835 (1854) ♀.
Cr. lineolata var. *cerasi* Emery, Zool. Jahrb. Syst., Vol. 8, p. 282 (1895) ♀.
Cr. lineolata var. *lutescens* Emery, Ibid., Vol. 8, p. 282 (1895).
Cr. (*A.*) *lineolata* subsp. *cerasi* var. *punctinodis* Enzmann, Jour. N. Y. Ent. Soc., Vol. 54, No. 2, p. 91 (1946) ♀ ♂.
Cr. (*A.*) *lineolata* subsp. *cerasi* var. *wheldeni* Enzmann, Ibid., p. 92 (1946) ♀.
Type loc: Indiana. Types: none known to exist.
Range: New Brunswick through New England and the North Atlantic States and southwestward through southern Ontario and the North Central States to eastern Colorado. A southern extension follows the Appalachian Highlands to the latitude of northern Georgia.

The southern extent of the range of *lineolata* is something of a problem. It has been reported from Florida by several investigators but it is doubtful if the typical form occurs in that state. I believe that most of the southern records for *lineolata* (especially the older ones) belong either to *atkinsoni* or the subspecies *subopaca*. As noted above, the typical *lineolata* occurs in the highlands of northern Georgia and Alabama but at lower elevations that far south it appears to be largely replaced by *subopaca*.

14. Crematogaster (Acrocoelia) lineolata emeryana (new name)

Cr. lineolata var. Emery, Zool. Jahrb. Syst., Vol. 8, p. 281 (1895) ♀. (variety described but included without a name under the typical form).
Type loc: Colorado. Types: none in this country.
Range: mountains of Colorado, New Mexico and Arizona.

This subspecies is characterized, as Emery noted in 1895, by its short, thick, divergent epinotal spines, its brownish red color and its small size (3 mm.). In addition the rugae on the dorsum of the thorax are strong and not obscured by the interrugal sculpture.

It is interesting to note that when Emery described this insect in 1895, he stated that if it should subsequently prove to be an alpine variety it should be given a name. While *emeryana* is scarcely an alpine form, it is a mountain-dwelling subspecies. I have, therefore, followed Emery's suggestion and given it his name.

15. Crematogaster (Acrocoelia) lineolata subopaca Emery

Cr. lineolata var. *subopaca* Emery, Zool. Jahrb. Syst., Vol. 8, p. 283 (1895) ♀.
Type loc: Virginia. Types: none in this country.
Range: low or moderate elevations in the South Atlantic States westward to Colorado and northern Texas and northward to the latitude of southern New England. The insect appears to be notably less abundant north of the latitude of Virginia.

The subspecies *subopaca* combines certain features of the typical *lineolata* and *punctulata*. The epinotal spines of *subopaca* are like those of *lineolata*. The pilosity of *subopaca* is like that of *punctulata*. The thoracic sculpture of *subopaca* is intermediate between that of the other two subspecies. This blending of traits would certainly suggest that *subopaca* is an intergrade were it not for the fact that most of the range of *subopaca* lies in a region where neither of the other two subspecies occur. For this reason *subopaca* may be considered a distinct subspecies and not an intergrade. It is worth noting that the subspecies *subopaca* is easier to recognize by hair pattern than by sculpture. This fact seems to have been generally overlooked, which is not surprising, since Emery based the form on sculptural characters only. But the thoracic sculpture of *subopaca* is subject to minor fluctuations over its entire range, whereas the more abundant erect hairs on the thorax appear to be remarkably constant except in the area where this subspecies intergrades with the typical *lineolata*.

16. Crematogaster (Acrocoelia) lineolata punctulata Emery

Cr. punctulata Emery, Zool. Jahrb. Syst., Vol. 8, p. 287 (1895) ♀.
Cr. lineolata var. *punctulata* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 479 (1908).
Cr. (*A.*) *opaca* var. *texana* Santschi, Wien Ent. Zeitung, Vol. 46, p. 91 (1929) ♀.

Type loc: Colorado. Types: none in this country.
Range: areas of low elevation in eastern Colorado, New Mexico and western Texas.

This insect certainly intergrades with *subopaca* in western Texas and, presumably, with the typical *lincolata* in eastern Colorado as well. There is, therefore, no reason why it should be given specific status. I believe that Santschi's variety *texana* is an intergrade between *punctulata* and *subopaca*. It will probably be impossible to determine the exact nature of *texana* in any case. This form was described from a single worker and it is highly doubtful that an examination of the type will be of much service. The insect should never have been described under such circumstances, but it seems reasonably clear that it is not related to *opaca*, as Santschi supposed. The insect which I regard as *opaca* occurs only in the mountains of southern Arizona.

17. Crematogaster (Acrocoelia) mormonum Emery

Cr. lineolata subsp. *coarctata* var. *mormonum* Emery, Zool. Jahrb. Syst., Vol. 8, p. 284 (1895) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 482 (1908) ♀ ♀ ♂.
Type loc: Salt Lake, Utah. Types: none in this country.
Range: known only from Utah, where it occurs in the Transition Zone.

Emery described *mormonum* from a few workers and this has led to considerable confusion as to the definitive characteristics of this species. In the original description of *mormonum* Emery pointed out that the antennal scapes surpass the occipital margin by an amount one and one half times as great as the maximum thickness of the scape. This character is true of the large workers of *mormonum* as well as the small ones and thus gives a good means by which *mormonum* can be separated from related species. But Emery did not stress this fact and the result has been that other western forms have been confused with *mormonum*. The smallest workers of *lacviuscula, vermiculata*, etc. also have long antennal scapes but this is not true of their large workers, in which the scape is short. Emery related *mormonum* to *coarctata* because of the similarity of cephalic sculpture in the two insects. It is possible that Emery is correct and that *mormonum* is an eastern race of *coarctata*. However, as I have seen nothing to indicate that *mormonum* intergrades with *coarctata* or with its southern subspecies *vermiculata*, it seems preferable to treat *mormonum* as a separate species. It may be added that *mormonum* is not related to

lineolata. The female of *mormonum* has a rectangular head, which is almost one third broader than long (mandibles excluded). No female of the *lincolata* complex shows a comparable cephalic structure.

18. Crematogaster (Acrocoelia) opaca Mayr

Cr. opaca Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 989 (1870) ♀.
Type loc: Mexico. Types: none in this country.
Range: mountains of southern Arizona south into Mexico.

Wheeler believed that *opaca* should include *punctulata* and *depilis* but it seems ill-advised to treat the two latter forms as subspecies of *opaca*. It may be admitted that all three insects are heavily punctate and to this extent they are related. But the punctuation in *opaca* is different from that of the other two forms. This difference appears to depend on the fact that in *opaca* the bottoms of the punctures are dull. Its surface appears matte-like and completely opaque in consequence. In the other two forms the bottoms of the punctures are shining. Thus in *punctulata* and *depilis* the surface has a feebly shining appearance even in the areas where the punctures are densest.

19. Crematogaster (Acrocoelia) pilosa Emery

Cr. lineolata subsp. *pilosa* Emery, Zool. Jahrb. Syst., Vol. 8, p. 285 (1895) ♀.
Type loc: District of Columbia (by present restriction). Types: none in this country. The specimens bearing cotype labels in the collection of the M.C.Z. seem to be a part of Pergande's original series and are probably authentic. It is not possible, however, to consider them cotypes (see below).
Range: Central Atlantic States, New Jersey to North Carolina.

In the original description of *pilosa* Emery attributed the name to Pergande who had, apparently, written him about the insect. It is difficult to see how Emery expected this to make Pergande the author of the species. Pergande never published any description of *pilosa* and the species clearly belongs to Emery, a fact which he later acknowledged. Although Emery considered *pilosa* to be related to *lineolata*, it appears to have closer affinities with *atkinsoni*. In the female of *pilosa* the sides of the head converge strongly in front of the eyes. This same condition is present in the female of *atkinsoni*. The distinguishing characteristic of *pilosa* is, of course, its extreme hairiness. In this respect it differs sharply from *atkinsoni*, in which the hairs are notably sparser, particularly on the gaster.

Genus MONOMORIUM Mayr

(Plate 25, figures 1–4)

The majority of the species which belong to Monomorium occur in the Old World. Its representation in North America is especially poor. There are only two (possibly three) endemic species in the United States, hence our native species are outnumbered by those which have been imported from other areas. The species *pharaonis*, *floricola* and *destructor* are tropicopolitan 'tramps' whose origin is uncertain but it seems clear enough that all three have been introduced. The exact status of *M. carbonarium* subsp. *ebininum* is difficult to determine for this form may be a native of the Antilles and its presence in Florida might be due to migration rather than to importation. Here again, however, the roving tendency of the insect makes it impossible to be sure of its status as a native form.

All the species of Monomorium which occur in North America are exceptionally adaptable in the matter of nest sites. They will utilize all manner of preformed cavities (I once saw a nest of *M. pharaonis* which had been built inside an eye-dropper) or adapt themselves equally well to nesting in the soil. This adaptability is coupled with a wide tolerance for various sorts of environment. Our native species seem equally at home in the arid semi-desert regions of the west and the humid, heavily wooded areas of the eastern and southern states. The introduced species are decidedly limited by temperature. None of them are able to tolerate the climatic conditions which occur over most of the United States, hence the majority of the field records for these species come from Florida or southern Texas. The northern records are almost invariably from greenhouses or dwellings. The behavior of *M. pharaonis* appears to offer the only exception to this general rule. This active and enterprising little ant is now so widely distributed in greenhouses throughout the country that there is ample opportunity for it to appear in northern stations whenever a mild year permits its egress. But while this insect has been taken in the field in stations as far north as New York, it may be doubted that such colonies survive unless the ants move to more sheltered quarters during the winter months.

Key to the species of Monomorium

1. The three segments which form the antennal club successively increasing in length; workers varying little in size, not at all dimorphic (Subgenus *Monomorium*) 2
   The first two of the three segments which form the antennal club subequal

in length; workers varying moderately in size and slightly dimorphic (Subgenus *Parholcomyrmex*) ..... *destructor*

2. Head and thorax densely punctate, opaque or very feebly shining; color clear, reddish yellow ..... *pharaonis*
   Head and thorax in large part or entirely smooth, strongly shining with only scattered, piligerous punctures; color not as above 3
3. The teeth which terminate the clypeal carinae distinct, with the clypeal edge between them bearing a marked, concave impression which is often carried back between the carinae as a triangular sulcus 4
   The teeth which terminate the clypeal carinae indistinct or absent, the clypeal edge between the carinae straight or very feebly impressed, not sulcate behind 6
4. Node of the petiole, in profile, somewhat higher than its base is long with the anterior peduncle about as long as the base of the node; mesopleurae and base of the epinotum rugulose or delicately striate 5
   Node of the petiole, in profile, approximately as high as it is long with the anterior peduncle notably shorter than the base of the node; mesopleurae and the base of the epinotum for the most part smooth and shining .... *minimum*
5. Clypeal teeth curved inward; length of worker 1.8–2.8 mm.; female 5.3–5.7 mm.; thorax of female ferrugineous, head and gaster darker, all with strong greenish reflections ..... *viridum*
   Clypeal teeth straight; length of worker 1.8–2.0 mm.; female 4.5–5.0 mm.; color of female brownish black to piceous black with faint bluish reflections sometimes present ..... *viridum* subsp. *peninsulatum*
6. Node of the petiole, in profile, notably higher than its base is long, the crest flat or very feebly impressed in the middle when seen from behind; color uniform piceous black ..... *carbonarium* subsp. *ebininum*
   Node of the petiole, in profile, lower than its base is long, the crest evenly convex when seen from behind; head and gaster sordid brown, thorax, petiolar nodes and appendages dirty yellow ..... *floricola*

Subgenus MONOMORIUM Mayr

1. MONOMORIUM CARBONARIUM EBININUM Forel

(Introduced ?)

M. carbonarium Forel (part) Mitt. München. Ent. Ver., Vol. 5, p. 8 (1881) ♀.

M. minutum var. *ebininum* Forel, Grandidier, Hist. Phys. Madagascar, Vol. 20, p. 165 (1891) ♀.

M. carbonarium subsp. *ebininum* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 423 (1908).

Type loc: St. Thomas, B. W. I. and Guatemala. Types: none in this country.

Range: scattered records from southern Florida and the Brownsville area of Texas.

2. Monomorium floricola (Jerdon)

(Introduced)

Atta floricola Jerdon, Madras Lit. Soc., Vol. 7, p. 107 (1851) ♀.
M. floricola Forel, Jour. Bombay Nat. Hist. Soc., Vol. 14, p. 686 (1902); Bingham, Fauna Brit. India, Vol. 11, p. 211 (1903) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 87, fig. d, e (1905) ♀; Emery, Deutsche Ent. Zeitschr., p. 664 (1908) ♀ ♀.
M. poecilum Roger, Berl. Ent. Zeitschr., Vol. 7, p. 199 (1863) ♀ ♀.
Type loc: India. Types: none in this country.
Range: southern Florida.

3. Monomorium minimum (Buckley)

M. minutum Mayr, Sitz. Akad. Wiss. Wien, Vol. 53, p. 506 (1866) ♀ (*nec M. minutum* Mayr, 1855).
Myrmica minimum Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 338 (1867) ♀ ♀.
M. minutum var. *minimum* Emery, Zool. Jahrb. Syst., Vol. 8, p. 274 (1895) ♀ ♀ ♂.
M. minutum subsp. *minimum* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 423 (1908).
M. minimum Wheeler, Jour. N. Y. Ent. Soc., Vol. 22, p. 42 (1914); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 564, pl. 8, fig. 31 (1947) ♀.
M. minutum subsp. *ergatogyna* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 269 (1904) ♀ ♀.
M. minutum subsp. *emersoni* Gregg, Psyche, Vol. 52, p. 66 (1945) ♀ ♀.
Type loc: Texas. Types: none known to exist.
Range: southeastern Canada and the northeastern United States southwestward to the Pacific coast. The insect appears to be extremely rare or absent over much of the Pacific northwest.

The writer can see no justification for the recognition of Wheeler's subspecies *ergatogyna* or Gregg's subspecies *emersoni*, both of which have been treated here as synonyms of *minimum*.

The discussion covering the above synonymy can be somewhat simplified if it is realized that the taxonomy of *minimum* has recently undergone a significant change. In 1943 Brown described a new species of Monomorium which he called *viridum* and two years later Gregg added another, *M. peninsulatum*. It is my belief that *peninsulatum* is a southern race of *viridum*, but this is beside the point. Both these forms are dark-colored insects and both resemble *minimum* closely. Hence, it is now no longer possible to hold that any black form of Monomorium occurring in the United States (except the introduced *ebininum*) must be referred to *minimum*. As I shall attempt to show in the following paragraphs, this previously accepted dogma has been

directly responsible for the recognition of *ergatogyna* and indirectly for that of *emersoni*.

It happens that the insect which Gregg called *peninsulatum* occurs widely in Texas and this ant may have been the form to which Buckley gave the name *minimum*. This seems impossible of exact determination but it is quite possible to show that it is the insect which Wheeler called *minimum* in 1904. At that time Wheeler's concept of *minimum* was based largely on specimens coming from Texas. Since he assumed that these Texas specimens were identical with Buckley's species, Wheeler was able to set up several infraspecific variants which differed slightly from what he regarded as the 'typical' *minimum*. Of these we need concern ourselves only with the subspecies *ergatogyna*. The circumstances under which this form was recognized are certainly unusual from a taxonomic standpoint. Wheeler made practically no effort to distinguish the worker of *ergatogyna* from that of *minimum*, contenting himself with the statement that they are 'merely somewhat smaller'. But Wheeler laid considerable stress on the differences shown by the female of *ergatogyna* and particularly on the fact that he considered this insect to be an ergatogyne. As will be shown later, all that this meant was that the female had never had wings. But since the type material of *ergatogyna* came from Catalina Island, Wheeler ingeniously developed the theory that this aptery was an adaptation to life on an oceanic island. It may be stated at once that this latter view has since been shown to be untenable. Apterous females, agreeing in all respects with those of *ergatogyna* have been secured at many mainland stations in western states. In addition, I have in my possession a series of females which Professor Cockerell secured on San Miguel Island. Most of these are in all respects comparable to Wheeler's specimens and show no signs that they have ever had wings. Indeed, one of them is a callow, a fact which allows no chance that the wings might have been present. But two of the series may, in my opinion, have had wings originally. The epimera are not fused with the scutum, as is the case with the apterous forms, and there are small projections present which look very much like the stumps of hind wings. It would appear, therefore, that *ergatogyna* does not always have apterous females and that there is no connection between the aptery of its female and life on an oceanic island. Finally, it is quite impossible to regard *ergatogyna* as an insular subspecies.

But these are by no means the only misconceptions which Wheeler held in regard to *ergatogyna*. It is my opinion that the female of this insect cannot properly be considered as an ergatogyne. In 1904, and for some years thereafter, Wheeler's concept of an ergatogyne was exceedingly liberal. According to the definition which Wheeler gave in 1910, an ergatogyne is 'a workerlike form with ocelli, large eyes

and a thorax more or less like that of the female but without wings'. There are some remarkable points in this definition. A female ant ordinarily has ocelli. Its eyes are customarily larger than those of its workers. If the thorax of an ergatogyne is like that of the female, then it follows that the only workerlike character cited by Wheeler is the lack of wings. Why then, should such an insect be called an ergatogyne? Needless to say, other myrmecologists have held a more restricted view as to the nature of the ergatogyne. As Emery employed the term it denotes a fertile female with a worker-like thorax. In fully developed ergatogynes, for example those which occur in the genus Leptogenys, the thorax is typically that of the worker. Indeed, the principal external difference between the ordinary worker and such ergatogynes is the more voluminous gaster of the latter. Hence it may be contended that the specimens which Wheeler regarded as ergatogynic females of *ergatogyna* do not deserve to be so considered. Their thoraces are typically female even to the presence of the smaller alar scutes. As noted above, the mesothoracic epimera are fused with the scutum but this seems to be the only feature which will distinguish these females from the normal type once the latter has been deälated. It seems plain enough that the females which Wheeler described could never have had wings, but aptery alone is not enough to make a female an ergatogyne.

I have stressed this point because it is my opinion that Wheeler secured a fallacious distinction in the case of *ergatogyna* by the use of the term ergatogyne. Most myrmecologists would, under the circumstances, expect a notable structural difference in the thorax of the female. Unless one has been able to examine the types of *ergatogyna* it is not apparent that, except for the minor differences mentioned above, the insects are exactly like the females of that form of *minimum* which occurs in the northeastern United States. It seems plain that Wheeler never clearly realized this fact. In 1914 he presented a brief description of the female of *minimum* in which the insect is characterized as having a length of 4.5 mm. with the head subopaque, longitudinally striate in front and coarsely punctate over the whole upper surface with the petiole distinctly pedunculate. This is obviously the insect which Gregg later described as *peninsulatum*. It is, of course, quite different in structure from the female of *ergatogyna*, but Wheeler was willing to assign to *minimum* specimens coming from the northern and northeastern United States whose structure agrees much more closely with that of *ergatogyna* than with that of the insect which Wheeler called *minimum*. The confusion on this point seems to have been the main reason for Gregg's description of the subspecies *emersoni*. The writer cannot see how this insect can be separated from *ergatogyna* for, as has been shown above, there is

reason to believe that the female of that form sometimes has wings and the presence of wings is the principal difference which Gregg used to distinguish *emersoni* from *ergatogyna*. Gregg's attempt to compare *emersoni* with the 'typical' *minimum* means very little for, if he was using Wheeler's criteria of the 'typical' *minimum*, he was comparing *emersoni* with his own *peninsulatum*. I do not believe that this was the case, but it is clear that as things stand at present the 'typical' *minimum* is largely what the observer chooses to make it.

There is little need to point out that this tangle calls for clarification. For the time being it seems hopeless to determine whether *ergatogyna* or *peninsulatum* is the same as Buckley's *minimum*, although one or the other must be identical with Buckley's species. Since both occur in Texas Buckley might have described either. But his description is worthless, even to indicate the genus, and if Mayr had not had specimens from Buckley it is probable that *minimum* would never have been recognized as a Monomorium. Under the circumstances there are two solutions possible. We can follow Wheeler in regarding as the typical *minimum* the insect which Gregg later described as *peninsulatum*. If this is done *peninsulatum* sinks as a synonym and Brown's *viridum* becomes a northern subspecies of *minimum*. But it will then be necessary to give specific status to *ergatogyna* and to include in this species much of the material which has previously been assigned to *minimum*. I regard this plan as unsatisfactory because of the confusion it is certain to produce. Specimens coming from the northern and eastern United States have been treated as *minimum* for so long that it cannot fail to cause trouble if the name is changed to *ergatogyna*. I have, therefore, followed the alternate plan of regarding Wheeler's *ergatogyna* as identical with Buckley's *minimum*. This enables *peninsulatum* to stand as a southern subspecies of *viridum* and, what is more important, preserves the name *minimum* for our common northeastern species of Monomorium. It should be borne in mind, however, that if the specimens which Buckley sent to Mayr are still in existence, an examination of these specimens may subsequently force an adoption of the first plan outlined above.

4. Monomorium pharaonis (Linné)

(Introduced)

Formica pharaonis Linné, Syst. Natur. Ed. 10, Vol. 1, p. 580 (1758) ☿.

M. pharaonis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 752 (1862); Mayr, Reise Novara, Formicid, p. 90 (1865) ♂; Mayr, Tijdschr. v. Ent., Vol. 10, p. 95 (1867) ☿ ♀ ♂; Saunders, Trans. Ent. Soc. Lond., p. 222 (1880) ☿ ♀ ♂; E. André, Spec. Hym. Europe, Vol. 2, p. 333 (1882) ☿ ♀ ♂;

Bellevoye, Soc. Études Sci. Nat. Reims, Vol. 1, p. 21 (1891) ♀ ♀ ♂; Forel, in Grandidier, Hist. Phys. Madagascar, Vol. 20, 2, p. 163 (1891) ♀ ♀ ♂; Forel, Jour. Bombay Nat. Hist. Soc., Vol. 14, p. 686 (1902) ♀; Bingham, Fauna Brit. India, Hym., Vol. 2, p. 201 (1903) ♀ ♀; Ruzsky, Formic. Imp. Rossici, Vol. 1, p. 633, figs. 160–162 (1905) ♀ ♀ ♂; Emery, Deutsche Ent. Zeitschr., p. 664 (1908) ♀ ♀ ♂; Donisthorpe, British Ants, p. 96, pl. 6 (1915); Forel, Fauna. Ins. Helvet. Formicid., p. 39 (1915); Emery, Bull. Soc. Ent. Ital., Vol. 47, p. 161 (1916) ♀ ♀ ♂; Arnold, Ann. S. African Mus., Vol. 14, p. 228 (1916) ♀ ♀ ♂.

Type loc: India? Types: none in this country.

Range: widespread in greenhouses and dwellings throughout the country. The insect has been able to adapt itself to field conditions in southern Florida.

In addition to the bibliographic citations presented above, *M. pharaonis* has been repeatedly described under other generic and specific names. Since the value of most of these descriptions is slight the references to them have not been included here. For a full bibliography of *pharaonis* see the *Genera Insectorum*, Fasc. 174, p. 173 (1921).

5. Monomorium viridum Brown

M. viridum Brown, Ent. News, Vol. 54, No. 10, p. 243 (1943) ♀ ♀.

Type loc: Lakehurst, New Jersey. Types: Coll. W. L. Brown.

Range: known only from type material.

Before Mr. Brown described *viridum*, he very kindly gave me specimens of this insect. I believe that these were a part of what later became the type series. The relationship of *viridum* to *minimum* has been discussed on a preceding page and need not be repeated here. Since *viridum* is at present known only from the type locality, nothing positive can be said at this time about its range. It seems probable, however, that the types were taken in the northern portion of the range. It will, I believe, not be easy to plot the range of *viridum* for the worker of this form is exceedingly like that of its southern subspecies *peninsulatum* and for certain separation of the two forms it will probably be necessary to secure the females. Unfortunately, the distinctive green coloration which is present in the female of *viridum* is not shown to any extent by the worker.

6. Monomorium viridum peninsulatum Gregg

M. peninsulatum Gregg, Psyche, Vol. 52, No. 1, p. 62 (1945) ♀ ♀.

Type loc: South Miami, Florida. Types: Coll. R. E. Gregg, A.M.N.H.

Range: Florida and the Gulf Coast States and west to Arizona. In the west the northern limit of the range appears to lie in southern Colorado.

The relationship of *peninsulatum* to *minimum* and the reasons for treating it as a subspecies of *viridum* have been discussed on a previous page.

Subgenus PARHOLCOMYRMEX Emery

7. MONOMORIUM (PARHOLCOMYRMEX) DESTRUCTOR (Jerdon)

(Introduced)

Atta destructor Jerdon, Madras Jour. Lit. Soc. ,Vol. 17, p. 105 (1851) ♀.

M. destructor Forel, Jour. Bombay Nat. Hist. Soc., Vol. 14, p. 686 (1902) ♀; Bingham, Fauna Brit. India, Hym., Vol. 2, p. 201 (1903) ♀ ♀ ♂; Emery, Deutsche Ent. Zeitschr., p. 665 (1908) ♀ ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 566, pl. 8, fig. 33 (1947) ♀.

Myrmica vastator F. Smith, Jour. Proc. Linn. Soc. Lond. Zool., Vol. 2, p. 71 (1857); F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 123 (1858) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 359 (1886).

Myrmica basalis F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 125 (1858) ♀; Mayr, Reise Novara, Formicid., p. 92 (1865) ♀; Emery, Ann. Mus. Stor. Nat. Genova, Vol. 16, p. 532 (1881) ♀.

Type loc: India. Types: none in this country.

Range: Florida and Tennessee.

As with most of the other introduced species of Monomorium it is probable that *destructor* makes permanently established nests out of doors only in Florida.

Genus XENOMYRMEX Forel

(Plate 26, figures 1-4)

Our only representative of this small but interesting Neotropical genus is *X. stolli floridanus* Emery which occurs in the southern part of Florida. The rarity of these insects and their discontinuous distribution has considerably limited our knowledge of their habits. There seems to be little doubt, however, that they form their small colonies in the cavities of twigs. The structure of the female shows a marked adaptation to such a type of habitat. The slender thorax and long, narrow abdomen of the Xenomyrmex female are strikingly similar to those of the females of certain twig-dwelling species of Solenopsis (*picta* etc.). To a lesser extent, these modifications are shown by the worker and male. This latter caste is remarkably small in contrast to the size of the female.

The worker and female of Xenomyrmex may be distinguished from the corresponding castes of Solenopsis, which they superficially resemble, by the eleven jointed antennae. Emery, in the *Genera Insectorum*, notes that Xenomyrmex possesses a three-jointed antennal club. While it is true that the antepenultimate joint of the funiculus is somewhat larger than the preceding joints it is much less bulky than the two terminal joints. This is particularly true of the worker which, in my estimation, could as well be regarded as possessing a two-jointed antennal club. The petiole of the female is notably rectangular in shape with scarcely any indication of a node above. Mayrian furrows are absent in the female.

The male of Xenomyrmex appears to be an extraordinarily delicate insect. There have been three specimens of this caste described and all of them have been more or less damaged. Emery's original description of the male of *floridanus* was based upon a damaged specimen and the two males belonging to this genus which the writer has examined (one of the subspecies *skwarrae*, the other of the subspecies *casta*) have both had the upper surface of the head caved in. It seems entirely possible that these damages are due to the thin integument of the male which collapses on drying. I mention this point because I have redrawn the single male of *skwarrae* on which Dr. Wheeler based his illustration published in 1932. My drawing is so unlike that of Dr. Wheeler that I would hesitate to believe that he utilized the same insect were it not the only one in the type series. A possible explanation lies in the supposition that Dr. Wheeler assumed that the cephalic damages of the male of *skwarrae* extended to the thorax as well. This is not the case. The shape of the thorax in the male of *skwarrae* is certainly peculiar but this is not due to damage to the thoracic sclerites. Unless I am very much mistaken, Dr. Wheeler attempted to reconstruct an "ideal" thorax for the male of *skwarrae*. In the illustration presented here no attempt has been made to compensate for such damage to the head as has been caused by drying. This may be misleading but at least the picture is an accurate replica of the type of *skwarrae*. I have utilized this related Mexican subspecies in the case of the male caste because there are no males of *floridanus* available. One further point relates to the presence of Mayrian furrows in the male of *skwarrae*. Emery described the male of *floridanus* as doubtfully possessing these structures. This seems curious in view of their very prominent development in the male of *skwarrae*. We are badly in need of more data concerning the males of Xenomyrmex.

Finally, I have synonymized Wheeler's subspecies *rufescens* with *floridanus*. The subspecies *rufescens* was based upon a single deälated

female which Wheeler took at Long Pine Key, Florida. It appears to be a very minor color variety of the typical *floridanus*. The head, thorax and petiolar nodes of the subspecies *rufescens* are reddish yellow while those of *floridanus* are blackish brown. Wheeler stated that the head and thorax of *rufescens* are wider than those of *floridanus*, but I cannot agree that this is the case. Careful micrometer measurements of the thorax of the type of *rufescens* give proportions that are identical with those of the females which Wheeler used as the basis for his description of the typical *floridanus*. I can see no difference in the two insects except color and this difference is certainly not suitable for subspecific distinction, especially when both insects come from southern Florida.

1. Xenomyrmex stolli floridanus Emery

X. stolli subsp. *floridanus* Emery, Zool. Jahrb. Syst., Vol. 8, p. 275 (1895) ♀ ♂; Wheeler, Revist. Ent., Vol. 1, fasc. 2, p. 135, fig. 2 a–d (1931) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 566, pl. 8, fig. 33 (1947) ♀.

X. stolli subsp. *rufescens* Wheeler, Revist. Ent., Vol. 1, fasc. 2, p. 137 (1931) ♀.

Type loc: Lake Worth, Florida. Types: U.S.N.M., M.C.Z.

Range: known only from southern Florida.

Genus Solenopsis Westwood

(Plate 27, figures 1–6)

The student of North American ants may count himself fortunate that so few species of this difficult genus occur in our latitudes. He is thus saved from the task of trying to distinguish the many tropical species whose worker caste shows an astonishing and baffling convergence. This problem is largely confined to the small monomorphic species belonging to the subgenus Diplorhoptrum. In general the larger species, particularly those which are polymorphic, may be distinguished readily enough. But this is mainly because of the structure of the large workers. Even in the polymorphic species there is a notable convergence of form in the case of the minor workers. This has placed a somewhat greater stress than is usually the case on the structure of the sexual forms. Both male and female castes appear to offer much better characters for specific determination than do the workers in many cases. The females of a fair number of species are known but we are sadly lacking in adequate knowledge of the male caste. When this is forthcoming extensive changes in the taxonomy of this group may be necessary.

In view of the structural uniformity which exists within the genus, these insects show a range of habits which is rather surprising. At one extreme we have the large and aggressive colonies of such species as *geminata* and *saevissima*. These insects prefer to make their nests in soil, although they will sometimes utilize rotten logs, and the nest is usually surmounted by a ragged mound of excavated soil. The workers forage actively and are pugnacious in the extreme. They have a particularly painful sting which accounts for their popular name of "fire ant". Wherever they occur they are a dominant note in the environmental picture and they are among the few species of ants which can justifiably be regarded as serious pests. Because of their omnivorous habits they are always turning up in unexpected situations. They have been known to damage the buds and tender twigs of young fruit trees and kill quail which are too young to leave the nest. In certain areas they are a chronic nuisance because their unsightly nests disfigure lawns.

At the other extreme one finds a number of small, monomorphic species, several of which are known to be thief ants. Their colonies are usually founded in close proximity to the nest passages of some larger species with which the tiny passages from the nest of the thief ant communicate. A steady pilfering of brood or other food from the nest of the larger species is carried on in such obscurity that the larger species rarely seems aware of its loss. These thief ants only occasionally forage above ground and are almost impossible to see when they do so because of their minute size. It has been my observation that these tiny insects are just as bad tempered and pugnacious as their larger congeners but their stings are so small that they have no effect on human skin.

Another common habit pattern among the small species of Solenopsis results from the preference for living in preformed cavities in plant tissue. They will sometimes inhabit hollow galls but more often they prefer to nest in twigs having a hollow pith cavity. The female of at least one species (*picta*) has an unusually narrow thorax and, while it may be only a coincidence that this species lives in hollow twigs, at least the thoracic structure of the female would enable her to move around more freely under such circumstances.

It is interesting to note that xerophilous or semi-xerophilous species have been produced in all three subgenera which occur in North America. *S.* (*Solenopsis*) *aurea* and its subspecies *amblychila* are known only from regions of great aridity in the southwestern United States and northern Mexico. The insect which Wheeler described as *maniosa* also shows a strong preference for desert life. But since this form is virtually identical with the eastern *xyloni*, which is cer-

tainly not xerophilous, it may be that the nesting habits of *maniosa* merely indicate a tolerance for a wide range of stations rather than a marked xerophily. So little is known about *S.* (*Euophthalma*) *huachucana* that any statement regarding its habits must be largely speculative. However, the fact that the type colony was taken at low levels in the Huachuca Mountains would seem to indicate at least a semi-xerophilous existence. Finally, we have three species which belong to the subgenus Diplorhoptrum, *krockowi, pilosula* and *salina.* None of these species is well known but our meager data seem to indicate a tendency towards xerophily in all three. It is worth noting that some of these desert-dwelling species are known to be crepuscular in habit.

Key to the species of Solenopsis

1. Second and usually the third funicular joint of the worker at least one and one-half times as long as broad (Subgenus *Solenopsis*) 2
   Second and third funicular joints of the worker at most very slightly longer than broad, usually broader than long 7
2. Mandibles of the major and the larger medias abruptly curved, the teeth aborted or absent 3
   Mandibles in all sizes of workers gradually curved with three or four well-developed teeth 4
3. Thorax bearing a mesoternal spine or projection . . . *geminata* subsp. *rufa*
   Mesosternum of the thorax without a spine or projection . . . . . *geminata*
4. The tip of the antennal scape of the minor worker surpassing the occipital border . . . . . *sacvissima* subsp. *richteri*
   The tip of the antennal scape of the minor worker not surpassing the occipital border 5
5. Eyes of the major consisting of 70–80 facets (about 50 in the minor) and separated from the insertion of the mandibles by a distance one and one half times as great as the maximum diameter of the eye . . . . . *xyloni*
   Eyes of the major consisting of not more than 50 facets (about 20 in the minor) and separated from the insertion of the mandibles by a distance twice as great as the maximum diameter of the eye 6
6. Clypeal teeth present in the major . . . . . *aurea*
   Clypeal teeth absent in the major . . . . . *aurea* subsp. *amblychila*
7. Eyes of the worker composed of twenty or more facets, or if less are present, the postpetiole is greatly dilated (Subgenus *Euophthalma*) 8
   Eyes of the worker with not more than fifteen facets present at most, and usually less than ten present (Subgenus *Diplorhoptrum*) 9
8. Postpetiole greatly dilated, more than half as wide as the gaster; epinotum finely and densely sculptured . . . . . *globularia* subsp. *littoralis*
   Postpetiole not dilated, scarcely more than one-third as wide as the gaster; epinotum smooth and without sculpture . . . . . *huachucana*
9. Head covered with numerous small but distinct punctures which are

clearly greater in diameter than the hairs which rise from them.....10
Cephalic punctures sparser and smaller, often visible only under high magnification and not much larger in diameter than the hairs which rise from them.....14

10. Postpetiole seen from above circular or nearly so, color pale yellow to milky white.....11
Postpetiole seen from above not circular in outline, the front or rear face or both faces somewhat flattened.....12

11. Head (mandibles excluded) distinctly longer than broad; the antennal scapes not extending more than two-thirds the distance to the occipital corners.....*longiceps*
Head (mandibles excluded) usually square, at most very slightly longer than broad; the antennal scapes extending a little more than three-quarters of the distance to the occipital corners.....*pergandei*

12. Node of the petiole seen from above a little wider than the postpetiole, and with a slightly concave posterior face.....*pilosula*
Node of the petiole seen from above not wider than the postpetiole, its posterior face not concave.....13

13. Anterior peduncle of the petiole with a prominent, sharp, ventral tooth.. *salina*
Anterior peduncle of the petiole with the ventral tooth blunt and compressed.....*krockowi*

14. Mesoepinotal suture of the thorax broadly impressed so that in profile the dorsum of the promesonotum is distinctly set off from that of the epinotum, the latter very broadly rounded and without a clear distinction between the basal and declivious faces; color piceous brown to black; thorax of the female slender.....*picta*
Mesoepinotal suture of the thorax not impressed so that in profile the dorsum of the promesonotum is confluent with that of the epinotum except for the narrow suture itself, epinotum more or less rounded at the junction of the basal and declivious faces but the faces clearly distinct; color pale yellow to castaneous brown; thorax of the female not slender.15

15. Female with very large eyes which cover more than half the sides of the head.....*carolinensis*
Female with smaller eyes which do not cover half the side of the head..16

16. Funicular joints 3, 4 and 5 of the worker notably broader than long, color pale yellow, the gaster of the female a pinkish orange in living specimens 17
Funicular joints 3, 4 and 5 only a little broader than long, color golden yellow or darker, the gaster of the female not pinkish orange in living specimens.....18

17. Pilosity very sparse, gastric segments of the worker not infuscated..... *texana* subsp. *catalinae*
Pilosity of medium abundance, gastric segments of the worker slightly infuscated.....*texana*

18. Length 2–2.5 mm.; head subquadrate, only slightly longer than broad; color deep castaneous brown.....*truncorum*

Length never in excess of 2 mm., usually less; head distinctly longer than wide; color golden yellow to sordid brownish yellow.....19

19. Length 1.5–1.7 mm.; color clear golden yellow (eastern and central states).....*molesta*

Length 1.8–2 mm.; color sordid brownish yellow (western states) *molesta* subsp. *validiuscula*

Subgenus SOLENOPSIS Westwood

1. SOLENOPSIS AUREA Wheeler

S. geminata var. *aurea* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 336 (1906) ♀ ♀; Wheeler, Ibid., Vol. 24, p. 425 (1908) ♀ ♂.

S. aurea Forel, Deutsche Ent. Zeitschr., p. 269 (1909).

S. xyloni subsp. *aurea* Creighton, Proc. Amer. Acad. Arts Sci., Vol. 66, No. 2, p. 103, pl. 2, fig. 2 (1930) ♀ ♀ ♂.

Type loc: Mt. Bonnel, Austin, Texas. Types: M.C.Z.

Range: desert areas in western Texas, New Mexico and Arizona.

2. SOLENOPSIS AUREA AMBLYCHILA Wheeler

S. aurea subsp. *amblychila* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 394 (1915) ♀.

S. xyloni subsp. *amblychila* Creighton, Proc. Amer. Acad. Arts Sci., Vol. 66, No. 2, p. 104, pl. 3, fig. 3 (1930) ♀ ♀ ♂.

Type loc: Huachuca Mts., Ariz. Types: M.C.Z., Coll. W. S. Creighton.

Range: mountains of southern Arizona into northern Mexico.

In 1930 I treated *aurea* and *amblychila* as subspecies of *xyloni*. Subsequent field work has, however, convinced me that Forel was correct in regarding *aurea* as a separate species. I have now collected in several areas where both *xyloni* and *aurea* occur and have never found any intergrades in such areas. Intergrades between *aurea* and *amblychila* are by no means uncommon. In addition to the lack of intergrades between *aurea* and *xyloni*, the two show a rather constant difference in nest construction. The nests of *aurea* and its subspecies *amblychila* are usually built in fully exposed positions in dry, coarse, gravelly soil and without any mound of heaped-up material above the nest. The nests of *xyloni* are usually built in sandy soil rather than gravel with an irregular mass of excavated soil surmounting the nest. The nests are often situated along stream bottoms and in the east, at least, they are frequently built in moderately shady positions where the sand is decidedly damp. In the vicinity of Ft. Davis, Texas, where the two species occur together, the nests of *aurea* were on the tops of exposed shoulders above stream bottoms while those of *xyloni* occurred in the sandy draw of the stream bottom.

3. Solenopsis geminata (Fabricius)

Atta geminata Fabricius, Syst. Piez., p. 423 (1804) ♀.
Formica geminata Roger, Berl. Ent. Zeitschr., Vol. 6, p. 289 (1862) ♀ ♀ ♂.
Solenopsis geminata Mayr, Tijdschr. v. Ent., Vol. 10, p. 109 (1867) ♀ ♀ ♂; Forel, Mitt. München Ent. Ver., Vol. 5, pl. 10 (1881) ♀ ♂; Creighton, Proc. Amer. Acad. Arts. Sci., Vol. 66, No. 2, p. 60, pl. 1, figs. 1, 4, 5, 6, 10, 11, 12 (1930) ♀ ♀ ♂.
Solenopsis mandibularis Westwood, Ann. Mag. Nat. Hist., Vol. 6, p. 87, pl. 2, fig. 5 (1841) ♀.
Myrmica virulens F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 132 (1858).
Atta clypeata F. Smith, Ibid., Vol. 6, p. 169 (1858) ♀ ♂.
Diplorhoptrum drewseni Mayr, Europ. Formicid, p. 71 (1861) ♀.
Myrmica glaber F. Smith, Trans. Ent. Soc. Lond. (3), Vol. 1, p. 34 (1862) ♀.
Myrmica polita F. Smith, Ibid., Vol. 1, p. 34 (1862) ♀.
Type loc: "Meridional America". Types: none in this country.
Range: the main range of this insect lies in Central America and the Antilles. In the United States it occurs from Texas to South Carolina. The majority of these records come from areas on or near the coast. As one goes inland the incidence usually decreases except in Florida, where the insect seems to be uniformly distributed over the entire state.

4. Solenopsis geminata rufa (Jerdon)

(Introduced?)

Atta rufa Jerdon, Madras Jour. Lit. Sci., Vol. 17, p. 106 (1851) ♀.
Solenopsis geminata Emery, Bull. Soc. Ent. Ital., Vol. 23, p. 166 (1892).
Solenopsis geminata subsp. *rufa* Forel, Jour. Bombay Nat. Hist. Soc., Vol. 14, p. 686 (1902) ♀; Creighton, Proc. Amer. Acad. Arts Sci., Vol. 66, No. 2, p. 66, pl. 1, figs. 7, 8 (1930) ♀ ♀ ♂.
Solenopsis geminata var. *rufa* Forel, Deutsche Ent. Zeitschr., p. 268 (1909); Bingham, Fauna Brit. India, Hym., Vol. 2, p. 158, fig. 64 (1903) ♀ ♀ ♂.
Solenopsis cephalotes F. Smith, Jour. Proc. Linn. Soc. Lond. Zool., Vol. 3, p. 149 (1858) ♀.
Crematogaster laboriosus F. Smith, Ibid., Vol. 4, suppl. p. 109 (1860) ♀.
Solenopsis geminata var. *diabola* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 424 (1908) ♀.
Type loc: southern India. Types: none in this country.
Range: largely coincidental with that of the typical form in the United States. In India and many parts of the East Indies *rufa* is the only form present.

It is difficult to evaluate the true status of *rufa*, which was at first regarded as native to southern Asia. As I attempted to show in 1930, this is a debatable point, since the American records give little evidence that *rufa* has been introduced here. The virtually coincidental

ranges of *rufa* and the typical *geminata* make it impossible to treat *rufa* as a geographical race and the fact that it intergrades with the typical *geminata* makes it equally difficult to treat *rufa* as a separate species. I am inclined to believe that the value of the mesosternal spine as a separatory character for *rufa* has been given more prominence than it deserves, because of the fact that *rufa* was first described from Asiatic specimens. These specimens are more constant in this character than those coming from the United States. In this country *rufa* behaves as a color variety and shows no geographical distinctions. I have retained it as a subspecies because this behavior may be a result of introduction.

5. Solenopsis saevissima richteri Forel

(Introduced)

S. pylades var. *richteri* Forel, Deutsche Ent. Zeitschr., p. 267 (1909) ☿ ♀.
S. saievissima var. *richteri* Santschi, Physis Buenos Aires, Vol. 2, p. 381 (1916); Creighton, Proc. Amer. Acad. Arts Sci., Boston, Vol. 66, No. 2, p. 87 (1930) ☿ ♀ ♂.
Type loc: Buenos Aires, Argentina. Types: none in this country.
Range: southern Alabama and Mississippi.

This insect was first reported from Mobile, Alabama, in 1930. It has since spread considerably and has become a serious pest in some areas. It constructs large mound nests which frequently cause damage to lawns. It is also said to damage the buds of shrubs and young fruit trees.

6. Solenopsis xyloni McCook

S. xyloni McCook, in Comstock's Rep. Cotton Worm, p. 188, fig. 47 (1879) ☿ ♀.
S. geminata subsp. *xyloni* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 395 (1915) ☿ ♀ ♂.
S. xyloni Creighton, Proc. Amer. Acad. Arts Sci., Boston, Vol. 66, No. 2, p. 99, pl. 3, figs. 1, 4–8 (1930) ☿ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 568, pl. 9, fig. 34 (1947) ☿.
S. geminata subsp. *maniosa* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 396 (1915) ☿ ♀ ♂.
S. xyloni var. *maniosa* Creighton, Proc. Amer. Acad. Arts Sci., Vol. 66, No. 2, p. 102 (1930) ☿ ♀ ♂.
Type loc: none given, presumably Texas. Types: none known to exist.
Range: South Carolina westward to California. There are no records of *xyloni* from Florida at present, although it must certainly occur in the region near Pensacola.

In my 1930 monograph of Solenopsis I gave reasons for believing that *maniosa* was closely related to *xyloni*. At that time the records seemed to indicate that it might be possible to treat the two as eastern and western races although, as I pointed out, the only difference lay in the lighter color of the minor worker of *maniosa*. Additional field work has convinced me that this difference is not reliable. While the minor worker of the typical *xyloni* is uniformly dark, that of *maniosa* is not always light. Since there seems to be no way of correlating these color variations with distribution, I have treated *maniosa* as a synonym of *xyloni*.

Subgenus EUOPHTHALMA Creighton

7. SOLENOPSIS (EUOPHTHALMA) GLOBULARIA LITTORALIS Creighton

S. (*E.*) *globularia* subsp. *littoralis* Creighton, Proc. Amer. Acad. Arts Sci., Boston, Vol. 66, No. 2, p. 113, pl. 6, fig. 3 (1930) ♀ ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 568, pl. 9, fig. 35 (1947) ♀.

Type loc: Baldwin County, Alabama. Types: M.C.Z., Coll. M. R. Smith, Coll. W. S. Creighton.

Range: Southern Atlantic Coast and the Gulf Coast from Florida to Mexico. In Alabama and Mississippi I have never taken this insect anywhere except on open beaches. The nests are usually constructed in or under rotten logs.

8. SOLENOPSIS (EUOPHTHALMA) HUACHUCANA Wheeler

S. huachucana Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 393 (1915) ♀ ♀.

S. (*E.*) *huachucana* Creighton, Proc. Amer. Acad. Arts. Sci., Boston, Vol. 66, No. 2, p. 119, pl. 7, figs. 5, 6, 7 (1930) ♀ ♀.

Type loc: Miller Canyon, Huachuca Mountains, Arizona. Types: M.C.Z., Coll. W. S. Creighton.

Range: known from type material only.

Subgenus DIPLORHOPTRUM Mayr

Before presenting the list of species which belong to the subgenus Diplorhoptrum, I wish to discuss certain revisionary changes which have been necessary in that group. On a previous page I have pointed out the difficulties which result from the convergence in the worker caste of the small species. To this may be added the further obstacle of their minute size. Since few of them exceed two millimeters in

length, size differences must be expressed in very small fractions of a millimeter. As a result, distinctions based on such differences are less reliable than is usually the case. Yet the major trouble is due to neither of the above causes but rather to the avoidance of full description of these tiny ants by the myrmecologist. Far too many subspecific variants have been set up on the basis of a brief comparison to a species which was itself imperfectly described. This has made for much confusion in the case of the *molesta-texana* complex, which is at present so involved that no adequate solution seems possible. It is possible, however, to eliminate at least some of the difficulty and I justify the somewhat extensive discussion which follows on this ground.

The *molesta-texana* tangle may be said to have begun in 1895, at which time Emery, acting on information from Pergande, shifted Say's *Myrmica molesta* to the genus Solenopsis. Prior to this, Emery had believed Say's species to be *Monomorium pharaonis* and it is abundantly clear that the change was made on other grounds than that of the original description. Emery's action necessitated the sinking of Mayr's name *debilis* (1886) and Buckley's *exigua* (1866) both of which became synonyms of *molesta*. In his preoccupation with this revisionary work Emery neglected to give any adequate description of *molesta*, although in the same paper he set up the variety *validiuscula* as well as *texana*, which he regarded at that time as related to *pollux*. In both cases recognition depended upon a comparison with previously described forms. In the case of *molesta*, two of the three existing descriptions are worthless for this purpose and the third (Mayr's *debilis*) is scarcely detailed enough to permit the use of the fine distinctions which were necessary in this case. In 1901 Forel gave *texana* specific status (without presenting a full description) and added to it the subspecies *truncorum* and *carolinensis*. In 1904 Wheeler added the subspecies *catalinae* to *texana* and in 1908 he recognized the variety *castanea*, which he attached to *molesta*. All four of these variants were set up by means of very brief comparisons to the species to which they were assigned. In the case of *molesta* one could refer to Mayr's original description of *debilis* but *texana* had never been described at all except in a roundabout, comparative fashion. It is no wonder that the character of the three forms assigned to *texana* has remained enigmatical.

In 1938 Dr. C. H. Kennedy described *rosella*. He dealt with all three castes in his description, figured them and noted how they differ from the corresponding caste in *molesta*. For the first time a species which had existed without adequate description since 1895 was put on a sound descriptive basis. For *rosella* is the insect that Emery,

Forel and Wheeler called *texana*. It is of course, necessary to sink *rosella* as a synonym of *texana*. I wish that this could be avoided for Dr. Kennedy's name is considerably more apt than *texana*. It stresses a color peculiarity of the female which is characteristic of this species. Moreover, *texana* is rare in Texas. It is much more abundant in the southeastern and central states and Emery was mistaken in supposing that this species is a representative of our southwestern ant fauna. In 1930 I had before me the types of *carolinensis*, *truncorum* and *catalinae* as well as specimens which Emery had pronounced identical with his *texana*. A study of these and much additional material has convinced me that several species have been lumped under *texana*. I believe that both *carolinensis* and *truncorum* are specifically distinct. Although the worker of *carolinensis* is very similar to that of *texana*, the females of the two species are notably unlike. The eyes of the female of *carolinensis* are unusually large and occupy more than half the sides of the head. Kennedy has pointed out that the eyes of the female of *texana* (*rosella*) are somewhat larger than those of *molesta* but the difference here is slight compared with the very large eyes of the *carolinensis* female. In the case of *truncorum* there are so many differences, even in the worker caste, that it is hard to see why Forel assigned it to *texana*. In *truncorum* the worker is larger, darker and more robust throughout, particularly the petiolar nodes, which are heavier and higher. The head is subquadrate rather than rectangular and the color is a very distinct, deep, castaneous brown. Finally, it is obvious that neither *carolinensis* nor *truncorum* should have been treated as subspecies of *texana* since all three occur in the same stations. Indeed Forel's two type series were both taken at Faisons. In the case of *truncorum* some additional observations are necessary. Wheeler redescribed this insect under the name *castanea*. I have compared the types of the two and find no differences by which they may be separated. I further cannot agree with Wheeler that there are intergrades which connect *castanea* with the western *validiuscula*. Or perhaps I should say with the insect which Wheeler and I have called *validiuscula*, for Emery's original characterization of that subspecies is loose enough to apply to either *validiuscula* or *truncorum*. It may be that an examination of the types of *validiuscula* will show it to be the same as *truncorum*. If so, it will then be necessary to give a name to the form which has passed as *validiuscula* since 1895. For this western subspecies of *molesta*, is in my opinion, perfectly distinct and not to be confused with *truncorum*. For the above reasons I would arrange the *molesta-texana* complex as follows:

S. (*Diplorhoptrum*) *carolinensis* Forel
" " *molesta* Say
" " " subsp. *validiuscula* Emery
" " *texana* Emery
= *rosella* Kennedy
" " " subsp. *catalinae* Wheeler
" " *truncorum* Forel
= *castanea* Wheeler

9. Solenopsis (Diplorhoptrum) carolinensis Forel

S. texana subsp. *carolinensis* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 345 (1901) ♀ ♀ ♂.
Type loc: Faisons, North Carolina. Types: M.C.Z.
Range: North Carolina and Tennessee to southern New England. This insect appears to be considerably rarer and more sporadic in distribution than *texana*, which occurs in the same stations as *carolinensis*.

S. carolinensis may be easily recognized if females are available for examination. The eyes of the female are much larger than those in related species. This difference is much more striking than the slight differences which distinguish the workers.

10. Solenopsis (Diplorhoptrum) krockowi Wheeler

S. krockowi Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 428, pl. 26, figs. 28, 29 (1908) ♀ ♀.
Type loc: Box Canyon, Sacramento Mts., New Mexico. Types: M.C.Z., Coll. W. S. Creighton.
Range: southern New Mexico south into Chihuahua.

11. Solenopsis (Diplorhoptrum) longiceps M. R. Smith

S. (*D.*) *longiceps* M. R. Smith, Proc. Ent. Soc. Wash., Vol. 44, p. 210 (1942) ♀.
Type loc: Hamilton County, Tennessee. Holotype: U.S.N.M., Paratypes: U.S.N.M.
Range: Florida to Texas and north to the latitude of Tennessee.

Despite the fact that *longiceps* is now known to have a rather extensive range, the insect appears to be nowhere very abundant. Its rarity has largely kept it out of the hands of collectors and this has limited our knowledge of its distribution. Thus there are no records

at present to show the occurrence of *longiceps* in Alabama, although it must certainly be present in that state.

12. Solenopsis (Diplorhoptrum) molesta (Say)

Myrmica molesta Say, Bost. Jour. Nat. Hist., Vol. 1, p. 293 (1836) ♀.
Solenopsis molesta Emery, Zool. Jahrb. Syst., Vol. 8, p. 277 (1895) ♀ ♀ ♂.
Myrmica minuta Say, Boston Jour. Nat. Hist., Vol. 1, p. 294 (1836) ♀.
Myrmica exigua Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 342 (1866) ♀ ♀.
S. fugax (part) Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 996 (1870) ♀.
S. debilis Mayr, Ibid., Vol. 36, p. 461 (1886) ♀ ♀ ♂.
Type loc: Indiana. Types: none known to exist.
Range: eastern and central United States from the Gulf Coast into southern Canada. The insect is rare in the southern portions of the Gulf States, where it is replaced by several other small species.

13. Solenopsis (Diplorhoptrum) molesta validiuscula Emery

S. molesta var. *validiuscula* Emery, Zool. Jahrb. Syst., Vol. 8, p. 278 (1895) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 430 (1908) ♀.
Type loc: San Jacinto and Los Angeles, California. Types: none in this country.
Range: Pacific Coast states eastward to Colorado and New Mexico.

14. Solenopsis (Diplorhoptrum) pergandei Forel

S. pergandei Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 343 (1901) ♀ ♀ ♂.
S. (D.) pergandei M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 568, pl. 9, fig. 36 (1947) ♀.
Type loc: Faisons, North Carolina. Types: none in this country.
Range: southeastern United States as far north as Virginia.

15. Solenopsis (Diplorhoptrum) picta Emery

S. tenuis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 262 (1886) ♀ (*nec S. tenuis* Mayr 1877).
S. picta Emery, Zool. Jahrb. Syst., Vol. 8, p. 278 (1895) ♀.
S. picta var. *moerens* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 393 (1915) ♀.
Type loc: Florida. Types: none in this country.
Range: Gulf States from Florida to Texas.

In my opinion Wheeler's variety *moerens* is a synonym of the typical *picta*. I have taken many colonies of this insect in southern Alabama

and Mississippi, where it nests in hollow twigs of various kinds. In every series of any length there are always specimens which meet the color requirements of the typical *picta* and others which are dark like *moerens*. It is unfortunate that Wheeler should have chosen to give a name to the six specimens which formed the type series of *moerens*.

16. Solenopsis (Diplorhoptrum) pilosula Wheeler

S. pilosula Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 426, pl. 26. figs. 26, 27 (1908) ♀ ♂.
Type loc: Alice, Texas. Types: M.C.Z., Coll. W. S. Creighton.
Range: known from type material only.

17. Solenopsis (Diplorhoptrum) salina Wheeler

S. salina Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 427, pl. 26, figs, 24, 25 (1908) ♀.
Type loc: Ft. Davis, Texas. Types: A.M.N.H., M.C.Z.
Range: western Texas to California and south into Mexico.

18. Solenopsis (Diplorhoptrum) texana Emery

S. pollux var. *texana* Emery, Zool. Jahrb. Syst. ,Vol. 8, p. 278 (1895) ♀.
S. texana Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 345 (1901).
S. rosella Kennedy, Can. Entomol., Vol. 70, p. 232, pl. 19, figs. 1–11 (1938) ♀ ♀ ♂.
Type loc: Texas. Types: M.C.Z.? (see below).
Range: central Texas to southern Ontario and the southeastern states.

This insect is considerably more abundant in the southeastern states than in Texas. In the western part of Texas *texana* is very rare and it seems to be altogether absent from southern New Mexico and Arizona. For this reason it may be that Wheeler's subspecies *catalinae* will ultimately prove to be a separate species. There is so little material of *catalinae* known at present that its status is problematical and, for this reason, I have left it as a subspecies of *texana*. It may be noted here that Emery sent specimens of *texana* to Wheeler. These specimens were treated by Wheeler as cotypes. While there is no doubt that they were identified by Emery as *texana*, it is not certain that they are a part of the type series of that species.

19. Solenopsis (Diplorhoptrum) texana catalinae Wheeler

S. texana subsp. *catalinae* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 269 (1904) ♀ ♀.
Type loc: Catalina Island, California. Types: M.C.Z.
Range: known from type material only.

20. Solenopsis (Diplorhoptrum) truncorum Forel

S. texana subsp. *truncorum* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 346 (1901) ♀ ♀.
S. molesta var. *castanea* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 430 (1908) ♀.
Type loc: Faisons, North Carolina. Types: M.C.Z.
Range: southeastern United States west to the Rockies.

I have no hesitancy in treating *castanea* as a synonym of *truncorum* even though Wheeler had the types of the latter insect before him when he described *castanea*. At that time he noted that *truncorum* is "very similar to *castanea* but has a paler thorax". This very slight color difference was the basis for the recognition of *castanea*, yet Wheeler secured a false distinction by assigning *castanea* to *molesta*. Since Forel had assigned *truncorum* to *texana* it was natural to infer that the two differed in other ways than color. Actually they do not, and the very minor difference of color which distinguishes *castanea* is of no significance as a separatory character. The reasons for treating *truncorum* as a species have been given in the discussion at the beginning of the subgenus Diplorhoptrum.

Genus Epoecus Emery

(Plate 28, figures 1–3)

The status of the genus Epoecus has been unsatisfactory from the outset. It was described in 1892 by Emery, who gave to the single species which represents Epoecus the name of its discoverer, Pergande. The material on which Emery based Epoecus was found by Pergande near Washington, D.C. It consisted of a series of males and females taken in a nest of *Monomorium minimum*. No workers of Epoecus were secured, a fact which led Emery to believe that the insect is a workerless parasite. On the other hand, the mixed nest contained not only workers of *minimum* but males and females of the "host" as well. Added to this unusual feature was the unexpected result which ensued when Pergande placed the mixed colony in a glass ob-

servation nest. The females of Epoecus attacked and killed the Monomorium males. This curious situation was known to Emery but he attempted no explanation for it. Subsequent observers have not hesitated to point out that the whole situation is decidedly irregular but there has been no opportunity to clarify it, since Epoecus has not been taken again.

In addition to these unexplained ecological peculiarities, the taxonomic position of Epoecus is by no means above reproach. In the original description of the genus Emery related it to Anergates. This he did on the basis of similarities in the clypeus, mandibles and antennae of the two genera. At the same time he pointed out that the general appearance of the two insects was entirely different. In 1895 Emery presented a somewhat more complete account of the structure of Epoecus. Here again he related the genus to Anergates on exactly the same morphological grounds as before. If one examines the description given by Emery of the mandibular and clypeal structure of Epoecus his association is not easy to understand. The mandible of the female of Epoecus is described as tridentate. The clypeus is said to be impressed in the middle but armed on the anterior edge with two teeth. As the mandible of the female of Anergates bears a single, mucronate point and the clypeal border, while deeply incised, is entirely without teeth, it would appear that the only feature by which the two genera might be related is the three-jointed club of the antennal funiculus. Such a similarity is scarcely enough to offset the striking differences which separate the two insects. These differences made very little impression upon Emery who attempted to augment structural features with a similarity of habit. At the end of his second description of Epoecus, Emery cited Pergande's observation on the killing of the Monomorium males by the Epoecus females and, thereupon, added that the habits of Epoecus united it with Anergates! In 1921 the first Myrmicine section of the *Genera Insectorum* appeared. In it Emery united Epoecus and Anergates in a subtribe (Anergatini) of the tribe Monomoriini. His third description of Epoecus carried one interesting new observation. The gastric dorsum of the female was described as "sunken in the middle, at least in dried specimens" (enfoncée au milieu du moins dans les exemplaires desséchés). How Emery could have overlooked such a significant character in his earlier work and why, after a quarter of a century, he suddenly discovered it, is not hard to explain. He needed further common characters to bolster the relationship between Anergates and Epoecus.

In the opinion of the writer there is scant basis for Emery's view. Very fortunately there is a part of the type series of Epoecus in this country. The females which I examined show no gastric sulcus nor,

for that matter, does the insect which Emery figured in 1895. The outstanding peculiarity of Epoecus is, as Emery noted, the strong similarity of the two sexes. The general body form is so nearly identical that it is difficult to tell the sex unless one examines the genitalia. This is a most unusual condition for an ant and one which is simply not comparable to the situation in Anergates. As far as the structure of the male is concerned there would seem to be no reason whatever for associating the two genera. It is to be hoped that future work will bring to light additional data on Epoecus. Only when we are better acquainted with this insect can there be much hope of clarifying its present unsatisfactory status.

1. Epoecus pergandei Emery

E. pergandei Emery, Ann. Soc. Ent. Fr., Vol. 61, p. 276 (1892) ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 8, p. 273, pl. 8, fig. 11, 12 (1895) ♀ ♂; Wheeler, Ants, Columbia Univ. Press, p. 498 (1910) ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 569, pl. 10, figs. 37, a (1947) ♀.

Type loc: Washington, D.C. Types: U.S.N.M., A.M.N.H., M.C.Z.

Range: known only from type material.

Genus Anergates Forel

(Plate 29, figures 1–3)

In 1934 I described, as a new species, a single winged female of the genus Anergates which had been taken in flight near Englewood, New Jersey. Since that time a number of other specimens of Anergates have been secured in the northeastern United States and an examination of some of this material has convinced me that Dr. Smith is correct in regarding my species *fricdlandi* as no more than a variant of the European *atratulus*. Although the two insects are by no means identical, several of the differences which I cited for *friedlandi* have proven too variable to be suitable for separatory characters. There are, on the other hand, certain minor differences between the American and European specimens which seem quite constant. If there were no question concerning the geographical status of the American material, it would be in accord with many other such cases to treat *friedlandi* as a subspecies of *atratulus*. I find it unsatisfactory to attempt to treat *friedlandi* as a subspecies as long as there is any possibility that this insect may have been imported. In my opinion this possibility is too remote for reasonable acceptance but as others do not share this view I have preferred to accede to Dr. Smith's treat-

ment of *friedlandi* as an insignificant variation of *atratulus*. I believe, however, that there is a very strong probability that it will later prove to be a North American subspecies of that form.

This extraordinary workerless parasite was first described by Schenck in 1852. This observer was also the first to publish on the habits of Anergates. It would be hard to imagine a more remarkable set of structural modifications than those which occur in both sexes of *atratulus*. The virgin female possesses a deep, median sulcus on the dorsum of the gaster. After fertilization the excessive development of the ovaries separates the gastric sclerites and stretches the intersegmental membranes between them. The lateral expansion is greater than the dorso-ventral stretching, with the result that the gaster of the fertile female finally assumes a shape rather like a biscuit. The separated sclerites appear like islands on the top and bottom surfaces. The structure of the male is even more aberrant. This sex is apterous and pupoidal. The body apparently never becomes fully chitinized. The gaster is curved under at the tip and provided with a disproportionally large set of genitalia. In both sexes the mandibles are poorly developed and apparently quite useless for purposes of feeding. It is no wonder that this insect has attracted much interest or that, despite its rarity, its habits have been repeatedly studied. While the significance of some of the observations is not altogether clear, there is good general agreement as to the behavior of this remarkable species. Anergates is a parasite of *Tetramorium caespitum*. At maturity a parasitized nest consists of a single fertile female of Anergates, a considerable number of *caespitum* workers and a large number of pupoidal males and virgin females of Anergates. The *caespitum* workers feed and care for the parasites but are particularly attentive to the males and much less interested in the females, (Adlerz 1913, Wasmann 1908). It was shown by Janet (1897) that the male of Anergates possesses unusually large mandibular glands and Forel (1922) supposes that the secretion from these glands is relished by the *caespitum* workers. Because the Anergates male is apterous, the nuptial flight has undergone some peculiar modifications. Copulation takes place between sisters and brothers (adelphogamy) within the confines of the nest. Mating is difficult for the clumsy, pupoidal male and is facilitated, as Forel has pointed out, (1922) by the docility of the female. After fertilization the female emerges from the nest for the nuptial flight. It is obvious that at the completion of the nuptial flight the Anergates female must find a nest of *T. caespitum* and gain access to it. Repeated experiments have been performed to ascertain how this is accomplished but the results have been uncertain in most cases. It is easy to show that the fertilized Anergates female

will try to gain access to the *caespitum* nest. This she does by making an unobserved entry or, in many cases, by seizing the antenna of a *caespitum* worker who thereupon drags her into the nest. What follows next is not so clear. In the great majority of cases the Anergates female is killed by the *caespitum* workers if we may judge from experimental data. In one case, however, there has been a different result. In 1912 Crawley succeeded in getting a colony of Tetramorium to accept an Anergates female. This colony contained sexual forms of the host. At the end of a week following the introduction of the Anergates female to the nest, the *caespitum* workers had killed and cut to pieces the *caespitum* males and females. The introduced female of Anergates later showed the characteristic gastric enlargement which marks the mature queen but died without having laid any eggs. In summing up the evidence concerning this and other experiments Donisthorpe (1915) expressed the opinion that the destruction of the Tetramorium female by her own workers is probably the normal sequence of events following the entrance of the Anergates female into a *caespitum* colony. It is difficult to see how else the *caespitum* female could be eliminated, since it is unlikely that the Anergates female could kill her.

1. Anergates atratulus (Schenck)

Myrmica atratulus Schenck, Jahrb. Ver. Nassau, Vol. 8, p. 91 (1852) ♀.

A. atratulus Forel, Fourmis Suisse, p. 68, pl. 2, figs. 28, 29 (1874) ♀ ♂; E. André, Spec. Hym. Europe, Vol. 2, p. 278, pl. 16, figs. 18, 19, pl. 18, figs. 1–6 (1882) ♀ ♂; Adlerz, Bih. Svenska Vet. Akad. Handl., Vol. 11, No. 18, p. 274, pl. 3, figs. 1–9 (1886) ♀ ♂; Wheeler, Ants, Columbia Univ. Press, p. 498, fig. 279 (1910) ♀ ♂; Donisthorpe, British Ants, p. 89, pl. 6 (1915) ♀ ♂; Forel, Fauna Ins. Helvet. Hym. Form., p. 17 (1915) ♀ ♂; Emery, Bull. Soc. Ent. Ital., Vol. 47, p. 168, fig. 44 (1916) ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 570, pl. 10, figs. 38, 38a (1947) ♀.

Tetramorium atratulum Mayr, Verh. Zool.- bot. Ges. Wien, Vol. 5, p. 249 (1855) ♀.

Tomognathus atratulus Mayr, Europ. Formicid., p. 56 (1861) ♀; Schenck. Jahrb. Ver. Nat. Nassau, Vol. 16, p. 164 (1861) ♀ ♂.

Anergates friedlandi Creighton, Psyche, Vol. 41, No. 4, p. 193 (1934) ♀.

Type loc: Nassau, Germany. Types: none in this country.

Range: (in the United States) Connecticut to northern Virginia.

Host: *Tetramorium caespitum*.

It seems advisable to note here the characters in which the American material of Anergates differs from that taken in Europe. In the

American specimens the mandible bears a much longer mucronate tooth or point; the eyes are smaller, more nearly circular, more strongly convex and with somewhat smaller facets; the lateral portions of the pronotum are more concave and blunter behind, so that when seen from the side they are quadrangular in outline; the gastric sculpture is heavier, with most of the upper surface of the gaster opaque. These differences hold for all the American specimens which the writer has seen.

The presence of Anergates in North America has an important bearing on the geographical status of its host, *Tetramorium caespitum*. I have shown elsewhere that there is no reason why *caespitum* may not be considered a native North American species. This probability becomes a virtual certainty in view of the presence of Anergates in this country. I may say at the outset that I do not doubt that *caespitum* could be introduced from Europe. It is likely that the insect has been brought into this country many times, perhaps even by the early colonists. But I cannot agree that the first advent of *caespitum* on this continent is a result of importation. To do so implies that Anergates has also been imported. I believe that it can be demonstrated that the probability for this having occurred is too remote to be credible.

It may simplify matters to consider first the conditions which attend the introduction of a free-living species. In general there are three critical factors involved. The insect must be sufficiently abundant in its home territory to make its chance inclusion in cargoes an easy matter. It must have the ability to endure the difficulties involved in transportation. It must find an area at the end of its voyage where the conditions are not widely dissimilar to those to which it has become accustomed. The nest-founding reactions of the ordinary female ant are ideally adapted to make it a successful stowaway. After fertilization the female usually seeks a protected spot and remains in it for a considerable period. Her self-effacing tactics make discovery difficult, and the transported female is likely to end her voyage in excellent shape. Since the female ant is such a good traveller, the hazards attendant on introduction are considerably reduced in her case. If the species is abundant in its native habitat and if transportation takes it to a climatically similar region, there is every reason to expect that successful introduction may ensue. Indeed, the chances are so good that it is difficult to explain why so few ants have been introduced into this country from Europe.

The entire situation changes radically in the case of a parasitic species such as Anergates. In the first place, the incidence of Anergates in Europe is exceedingly low. It is one of the rarest of Euro-

pean ants, and the chance for its accidental inclusion in a cargo is remote. In the second place, the nest-founding reactions of the Anergates female are unfavorable for purposes of transportation. The insect does not seek a secluded spot after fertilization, but becomes active in searching out colonies of the host, to which it must promptly gain admission if it is to survive. Not only is it unlikely that a single, fertilized female could be included in a cargo but it is even more unlikely that it could survive if this happened. That such a female could be disembarked at the end of the voyage and then discover and parasitize a nest of the host is plainly incredible. Those who wish to believe that Anergates has been introduced into the United States must assume, therefore, that the introduction involved the transportation of a parasitized nest of the host, *caespitum*. As may be seen, this is a much more difficult matter than the shipment of a single fertilized female. For the nest must not only have survived the voyage but it must have been reestablished intact at the end of it. Furthermore, this reestablishment must have occurred in an area where there was an abundant population of the host already present. I do not say that it is impossible for such a thing to have happened. I do say that every probability is dead against it. If Anergates has managed to accomplish this miracle, it has been favored with the most stupendous piece of luck that any parasitic species ever enjoyed. A much more reasonable view is that Anergates reached North America as a result of natural means of dispersal. If so, its host, *Tetramorium caespitum*, must have acted in the same way. In my opinion, therefore, the presence of Anergates on this continent constitutes sufficient evidence to permit us to treat *Tetramorium caespitum* as a native North American ant.

Genus EREBOMYRMA Wheeler

(Plate 30, figures 1–5)

As far as the writer has been able to determine, there have been no additional records published for *Erebomyrma longi* since its description by Wheeler in 1903. This is unfortunate, since we know very little about the biology of this insect, and there are indications that its habits would repay careful observation. Erebomyrma is closely related to several other genera (Oligomyrmex, Carebara, etc.) which are known to be lestobiotic in the nests of termites or other ants. It has been assumed that this relationship is also true of Erebomyrma. While there is no reason to doubt that Erebomyrma is lestobiotic, it should be remembered that the principal evidence for this supposi-

tion has been derived from the structural similarities between this genus and the others mentioned above.

In size, coloration and general body form the worker of *longi* closely resembles that of *Solenopsis molesta*. With proper magnification, however, a number of significant differences may be readily seen. The antennae are eleven-jointed in *longi*, with the extra joint occurring in the series of small segments which separate the first funicular joint from the two-jointed club. In addition, the epinotum is armed with two short, erect teeth and is densely rugose-reticulate. This sculpture is also present on the mesopleurae and the base of the petiole. The female of *longi* also possesses eleven-jointed antennae. This, of course, will not distinguish it from the Solenopsis female, in which the number of antennal joints is eleven (except in the subgenus Diagyne). The *longi* female is not apt to be confused with Solenopsis because of its heavy sculpture, short antennal scapes, dentate epinotum and the peculiar shape of the postpetiole, which has a concave anterior face and a strongly convex posterior face when seen from above. The male of Erebomyrma has thirteen-jointed antenna, one more joint than is present in the male of Solenopsis. In addition the Erebomyrma male is more heavily sculptured than is generally the case with those of Solenopsis and its postpetiole is extensively fused with the gaster over its entire posterior face.

1. Erebomyrma longi Wheeler

E. longi Wheeler, Biol. Bull., Vol. 4, p. 140, figs. 1–5 (1903) ♀ ♀ ♂; Wheeler, Ants, Columbia Univ. Press, p. 428, figs. 257 a–e (1910) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 571, pl. 11, fig. 39 (1947) ♀.

Type loc: Denton, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.

Genus Myrmecina Curtis

(Plate 31, figures 1–5)

The genus Myrmecina is divisible into two components which are marked by widely different geographical characteristics. The larger group consists of those species whose distribution extends from southeastern Asia through the East Indies and Oceania into northern Australia. The second and smaller group comprises the holarctic representatives which occur in Europe, northern Asia and the United States. The taxonomic development of the two groups has been en-

tirely different. There has been practically no specific subdivision in the case of the paleotropical forms, while the holarctic representatives have been consistently lumped under a single species, *graminicola*. This practice has not always led to satisfactory results. In 1915 Emery proposed to separate *sicula*, long regarded as a variety of *graminicola*, as a distinct species. This change was made on the basis of the unarmed clypeus of *sicula*, which lacks the three teeth characteristic of the typical *graminicola*. It happens that the three representatives of Myrmecina which occur in North America have the clypeal teeth reduced to a degree which would relate them to *sicula* rather than to *graminicola*. There is no need to make such a shift of relationship, since there is a much better alternative. If *sicula* deserves to be regarded as specifically distinct, our three forms may also be considered as variants of a separate species. This is the plan which I propose to follow in the present work. Of these three forms, two, *americana* and the subspecies *brevispinosa*, were described by Emery in 1895. The third variant, the subspecies *texana*, was set up by Wheeler in 1908. The following discussion will deal mainly with *americana* and *brevispinosa*, since *texana* is known only from a small series of types.

When Emery described *americana* and *brevispinosa* he was dependent upon material coming from the northeastern United States. As I shall presently show, the situation in this area is an exceptionally difficult one to analyze as far as the genus Myrmecina is concerned. Emery based his distinction on three points. His *americana* was larger, darker and had longer epinotal spines than *brevispinosa*. The color diagnostic is very unsatisfactory and generally inapplicable but the other criteria deserve careful consideration. The large individuals with long and slightly upturned epinotal spines which come from the northeastern United States show, in addition to these features, a strong cephalic sculpture consisting of wavy longitudinal rugae and a broad, V-shaped impression in the occipital border. Individuals with these characteristics are commonly met with from New England south to Washington but in more southern areas they tend to occur in the Appalachian highlands at considerable elevations. The smaller individuals with short spines which come from the New England and Atlantic states are decidedly variable as to the degree of development of the cephalic rugae and also as to the occipital impression. As one goes west, however, this variability gives way to a condition in which the head is finely punctate with the longitudinal rugae very feeble in the middle and clearly visible only at the sides. In addition, the occipital emargination is much more feeble. This is the form which occurs from Texas to Arizona. Unless I am very much mistaken, Emery's

brevispinosa is actually an intergrade between the small and rather smooth western subspecies and the larger, heavily sculptured eastern form. It is true that the area of intergradation of the two is much more extensive than is usually the case. Indeed, this area of intergradation appears to extend all along the base of the Appalachians and as far west as the Mississippi. At the same time, each subspecies occupies a separate range, although in the case of the eastern race the separation is more a matter of elevation than latitude. In order to overcome the difficulty of dealing with a name attached to an intergrade, I propose to expand Emery's definition of *brevispinosa* to include the characteristics of the western specimens. This practice has already been sanctioned by other myrmecologists who have generally regarded the western specimens as representing the 'typical' *brevispinosa*.

The nests of *americana* and *brevispinosa* are small and obscure. There are rarely more than one hundred individuals in a colony. The nests are usually built in moist, shady areas, often under small stones. The insects are very timid and feign death when disturbed. Forel claims that the European *graminicola* has a faint odor suggestive of raspberries. To the writer the odor of a living colony of *americana* resembles camphor, although it may be admitted that I have never found anyone else who thought so.

Key to the subspecies of Myrmecina americana Emery

1. Base of the first gastric segment finely punctate and subopaque..... *americana* subsp. *texana*
   Base of the first gastric segment smooth and shining, the sculpture consisting of scattered piligerous punctures.....2
2. Epinotal spines long and usually turned upward at their tips; cephalic rugae heavy; occipital border with a pronounced median impression; length 3.5 mm..... *americana*
   Epinotal spines short and dentiform; cephalic rugae weak, often absent at the middle of the head; occipital border feebly impressed; length 2.5 mm. *americana* subsp. *brevispinosa*

1. Myrmecina americana Emery

M. latreille Mayr, Verh. Zool-bot. Ges. Wien., Vol. 36, p. 455 (1886) ♀, (*nec latreille* Curtis).

M. latreille subsp. *americana* Emery, Zool. Jahrb. Syst., Vol. 8, p. 271 (1895) ♀.

M. graminicola subsp. *americana* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 572, pl. 11, fig. 40 (1947) ♀.

M. graminicola subsp. *quadrispina* Enzmann, Jour. N. Y. Ent. Soc., Vol. 54, No. 1, p. 13, figs. 1, 2 (1946) ♀.
Type loc: District of Columbia. Types: U.S.N.M., M.C.Z.
Range: southern New England west to Iowa and south to the highlands of northern Georgia and Alabama. In the southern part of its range the insect occurs at elevations of 2000 feet or more.

The insect which Enzmann has recently described as *Myrmecina graminicola* subsp. *quadrispina* is quite obviously a synonym of *americana*. It is difficult to understand how such a mistake could have occurred, for not only are there type specimens of *americana* present in American collections but, in addition, Emery's original description of *americana* embodies most of the points which Enzmann cited as the definitive criteria of *quadrispina*. Thus Emery stated that a rudimentary clypeal tooth is present in *americana* and that its epinotal spines are approximately as long as their bases are wide, pointed and notably thin at the tips which are curved outward and upward. Since the types of *americana* came from the District of Columbia, there is no reason why Enzmann should have chosen to regard specimens with short, straight spines which came from Texas and Arizona as representatives of *americana*. These specimens are referable to the subspecies *brevispinosa*. Although the length of the epinotal spines varies considerably in *brevispinosa* it shows certain sculptural peculiarities which distinguish it from the typical *americana*. It is instructive to note that Enzmann has cited some of these sculptural features as characteristic of '*americana*.' In 1941 Buren suggested that *americana* probably deserved full specific rank. Since he did not act on this eminently sound suggestion it has remained for the writer to put it into practice.

2. Myrmecina americana brevispinosa Emery

M. latreille subsp. *americana* var. *brevispinosa* Emery, Zool. Jahrb. Syst., Vol. 8, p. 271 (1895) ♀ ♀ ♂.
Type loc: District of Columbia. Types: U.S.N.M., M.C.Z.
Range: southeastern United States west to Arizona and north through the Piedmont as far as southern New York.

As has been shown elsewhere it is virtually certain that the types of *brevispinosa* are intergrades between the two races of *americana* which occur in the eastern United States. While the northern race is correctly designated as the typical *americana* the southern race, which exhibits its most characteristic condition in the southwestern states, has no name unless we expand the definition of *brevispinosa*

to include the western specimens. It seems much better to do so than to become involved in the difficulties which are certain to arise if the name *brevispinosa* is discarded. It should be remembered, however, that under this plan the characteristics of *brevispinosa* will be more extreme than those cited by Emery.

3. Myrmecina americana texana Wheeler

M. graminicola subsp. *texana* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 422 (1908) ♀.
Type loc: Shoal Creek, Austin, Texas. Types: M.C.Z.
Range: known only from western Texas.

The status of this insect cannot be certainly determined until we know more about its range. Since it appears to occur in the middle of the range of *brevispinosa*, it is very unlikely that it is a geographical race of *americana*. When more material is available for examination, *texana* will probably prove to be a separate species, for it has rather distinct structural features which separate it from *americana*. Since so little is known about it at present, it seems best to retain it provisionally as a subspecies of *americana*.

Genus Macromischa Roger

(Plate 32, figures 1–3)

The three species of this beautiful genus which occur in the United States are all closely related to other species whose range lies further to the south. As Dr. M. R. Smith pointed out in 1939, *floridanus* is strikingly similar to the Bahaman species *M. allardycei*. A similar relationship connects the Texan species *subditiva* to *laevissima* of Mexico, while *polita*, which occurs in southern Arizona, shows structural affinities with *flavitarsus* of Guatemala. At present it seems entirely satisfactory to treat our three representatives as separate species but the possibility should be borne in mind that, when the genus Macromischa is more carefully studied, it may be necessary to reduce one or all of them to subspecific rank.

It has now been shown that the three subgenera which Mann proposed for Macromischa in 1920 are indefensible. As a result, the genus must be treated as a single taxonomic unit. It is unfortunate that this view, which rests upon evidence of the strongest character, should have been obscured by Wheeler's refusal to abandon the older plan. Wheeler not only championed Mann's subgenera but at one time he

proposed that they be given generic rank. This proposal, which appeared in 1931, was made without any reference to additional facts which might have supported the elevation. In this same year Dr. C. G. Aguayo published evidence that makes it impossible to separate Macromischa and Croesomyrmex even on a subgeneric basis. Dr. Aguayo had discovered a new subspecies of *wheeleri* (the subgenotype of Croesomyrmex) that has short but distinct epinotal spines. This is the characteristic that supposedly distinguishes Macromischa from Croesomyrmex. Five years later Dr. M. R. Smith discovered a parallel situation in the case of the Puerto Rican species *isabellae*. Here the typical form belongs to Macromischa, for it has well-developed epinotal spines. But Dr. Smith's subspecies *mutica* lacks epinotal spines and, as a result, it would have to be placed in the subgenus Croesomyrmex. It is astonishing that Wheeler persisted in holding out for the validity of the subgenera of Macromischa in the face of this evidence (1937). It is difficult to see how anyone would be willing to accept the situation in which a species would have to be split between two subgenera. The writer fully agrees with Dr. Smith that the subgenera of Macromischa are indefensible as defined at present. Until better separatory characters can be found, it is imperative that this genus be treated as a single unit. The following key is that presented by Dr. Smith in 1939.

Key to the species of Macromischa

1. Antennal scape robust, short, not quite reaching half way between the eye and the posterior border of the head; sculpturing of the head, thorax, petiole and postpetiole rugose-reticulate; eye with unusually large facets; color yellow to yellowish brown ..... *floridanus*
   Antennal scape slender and extending further posteriorly; sculpturing not as above; eye with smaller facets 2
2. Peduncle of the petiole at least twice the length of the petiolar node; the latter short; pilosity of the scape closely appressed; color light brown to piceous brown ..... *subditiva*
   Peduncle of the petiole no longer than the length of the petiolar node, the latter long; pilosity of the scape suberect; color blackish ..... *polita*

1. Macromischa floridanus Wheeler

M. floridanus Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 72, p. 27 (1931) ♀; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 32, No. 3, p. 507, fig. 1c (1939) ♀.

Type loc: Paradise Key, Dade Co., Florida. Types: M.C.Z., U.S.N.M., Coll. W. S. Creighton.

Range: known only from type material.

The nest of the type series of *floridanus* was found in the hollow branch of a small tree. It is evidently arboreal, hence Wheeler's original assignment of this species to the supposedly terricolous subgenus Antillaemyrmex is a further evidence of the impossibility of attempting to separate Macromischa into satisfactory subgenera.

2. Macromischa polita M. R. Smith

M. polita M. R. Smith, Ann. Ent. Soc. Amer., Vol. 32, No. 3, p. 506, fig. 1b (1939) ♀.

Type loc: Tucson area, Phoenix, Florence, Arizona. Types: U.S.N.M., A.M.N.H.

Range: central and southern Arizona.

Although a single nest of *polita* was found under the bark of a cottonwood tree, most of the specimens belonging to this species have been taken on the ground. There is little to indicate that it is arboreal.

3. Macromischa subditiva Wheeler

M. subditiva Wheeler, Psyche, Vol. 10, p. 99, fig. 5 (1903) ♀; Mann, Bull. Amer. Mus. Nat. Hist., Vol. 42, No. 8, p. 409 (1920) ♀; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 32, No. 3, p. 503, fig. 1a (1939) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 572, pl. 11, fig. 41 (1947) ♀.

Type loc: worker, Walnut Creek, Austin and New Braunfels, Texas; female and male, Victoria, Texas. Types: worker, M.C.Z.; female and male, U.S.N.M.

Range: central Texas from Austin south to the Brownsville region.

The range of this species undoubtedly extends into northeastern Mexico, although to date there seem to be no records from areas south of the border. *M. subditiva* may be arboreal but data on this point is inconclusive. It has been taken from nests under willow bark and from dead, hollow branches lying on the ground.

Genus Leptothorax Mayr

(Plate 33, figures 1–4)

The revisionary steps which established the subgenera of Leptothorax were begun toward the end of the last century. By 1915 the present five subgenera had been set up and since that time no further change has been accepted. This stability is remarkable in view of the

fact that two of the groups are structurally heterogeneous. The subgenera Goniothorax and Leptothorax include some species with eleven-jointed antennae and others in which the antennae have twelve joints. In most ant genera the number of funicular joints is constant. Conversely, a funicular organization which involves a different number of joints is usually accompanied by other significant structural peculiarities. The prevalence of such conditions has given rise to the belief that in myrmecology the number of antennal joints is an important generic or subgeneric criterion. The radical departure from this stand in the case of the subgenera of Leptothorax merits careful consideration. It has given rise to confusion in the past and this confusion has not been limited to the novice.

Although the subgenera of Leptothorax were delimited by several workers, the outstanding contribution to the constitution of this genus was made by Carlo Emery. In 1915 he published a scheme which embodied the basic subgeneric distinctions at present employed. Emery was fully aware of his heterodox views concerning the subgenera Leptothorax and Goniothorax and was at some pains to explain his position. It may be added that in the face of subsequent criticism Emery stuck to his guns with such pertinacity that as yet no one has dared to propose a better system. Yet Emery's views, while generally accepted, are far from satisfactory. Emery based his contentions primarily on the venation of the winged sexes. In the subgenera Mychothorax and Dichothorax the radial cell is long and open. In the subgenera Leptothorax, Goniothorax and Temnothorax the radial cell is short and closed. A further consideration of the last group of subgenera gave another venational distinction. The presence of a discoidal cell in the subgenera Leptothorax and Temnothorax distinguished these groups from Goniothorax, in which the discoidal cell is absent. So far Emery's position is easily defensible, if one is prepared to accept the proposition that the venation of the various groups is constant. In the subgenera Leptothorax and Temnothorax, however, the venation is identical. In separating these two groups Emery relied upon differences in the body hairs and the presence or absence of the mesoepinotal suture in the worker. Since both these characters show intergrading conditions, it is not clear why Emery championed their significance while denying equal significance to the clear-cut, non-intergrading character of the number of antennal joints. Yet Emery was very positive on this score. When Wheeler and Forel separately proposed to delete from Goniothorax those species having eleven-jointed antennae (the subgenus Nesomyrmex Wheeler or Caulomyrma Forel) Emery denied the validity of the proposal. It is difficult to escape the impression that Emery, despite the

evidence which he accumulated to prove his point, was actually exerting the taxonomist's prerogative and basing his subgenera on general structural similarities which are more easily seen than described. If so, he was largely justified. The majority of the species which Emery included in the subgenus Leptothorax are, despite the difference in the number of antennal joints, obviously of close relationship. Yet the matter of the funicular variation has been a serious stumbling-block in the taxonomy of the group. It undoubtedly worried Emery himself, since he regarded the species having eleven-jointed antennae as "exceptional". This is true enough if one is dealing with the Old World representatives. There is but one species, the Mediterranean *flavicornis*, which shows the "exceptional" condition against sixty-eight species in which the antennae are twelve-jointed. In the North American species, however, the situation is different. More than a third of the New World species in the subgenus Leptothorax possess eleven-jointed antennae. It may be doubted that the student of North American ants will consider a condition which he finds in every third species of Leptothorax as "exceptional". He must learn to evaluate existing generic keys, particularly that published by Wheeler in 1922. This key failed to take account of the variable number of antennal joints in the subgenus Leptothorax. The number is given as twelve, hence all members of the subgenus Leptothorax which have eleven-jointed antennae will key out to the subgenus Mychothorax. Perhaps this is less of a misfortune than might appear at first sight. At least the writer has been unable to see that the mesoepinotal suture of the worker in Mychothorax is a suitable character for a major key split. In the key which is presented in the following pages no attempt has been made to separate the subgenera. The important part played by the sexual forms of Leptothorax in subgeneric delimitation seriously limits the possibility of making such distinctions in a key based entirely on worker characteristics.

Because of their inconspicuous habits and the small size of their colonies, the ants of the genus Leptothorax may be easily overlooked. They are, nevertheless, an exceedingly interesting group and one which is ideal for laboratory study because of the ease with which they adapt themselves to artificial nests. This adaptability is probably an outcome of the fact that many of the species nest by choice in preformed cavities. They may be found nesting in crannies beneath rock chips which have flaked from the tops of ledges, in cavities in and under bark, in hollow twigs, in dried grass stems, in old galls and in empty nut shells. Most of the species will, on occasion, nest in the soil and some do so as a matter of preference. There also seems to be a notable tendency for these insects to build their nests so that they

adjoin the nest of some other, larger species of ant. In most cases the relationship between the two species is of a very low order, with the activities of the Leptothorax workers largely confined to pilfering food from the other nest (lestobiosis). In one instance, however, a more intimate relationship has arisen. In 1901–02 Wheeler published several papers dealing with the ecology of *provancheri*, which he called *emersoni*. This species is an inquiline of *Myrmica brevinodis*. Wheeler was able to show that while *L. provancheri* builds its nests so that the passages open into those of the 'host' species, it vigorously excludes the larger ants from its own nest. In the passages of the Myrmica nest, however, the two species mingle on an entirely amicable basis. The Myrmica workers seem inordinately fond of the little inquilines. The latter climb upon the bodies of their hosts and spend much time licking or 'shampooing' the surface of the Myrmica workers. It seems clear enough that this peculiar activity produces definite benefits in the case of the Leptothorax workers. It is probable that they secure an edible surface secretion thereby and it is certain that they gain food by so doing. For the Myrmica workers will solicit a back-scratching by regurgitating food to the Leptothorax workers. What the Myrmica workers gain, aside from a thorough cleaning, is not clear. Wheeler regarded this relationship as a form of symbiosis (xenobiosis), but it would seem to be a rather lop-sided matter in which most of the benefits accrue to the Leptothorax workers. It seems to me that what is going on is actually a rather subtle form of exploitation but perhaps I underestimate the value of cleanliness to the Myrmica workers.

The passive role played by *longispinosus* and *curvispinosus* in the slave raids of Harpagoxenus has long been known but it was not until 1937 that a slave-making species of Leptothorax was discovered. In that year R. G. Wesson described the species *duloticus* and in 1940 presented an account of its habits. *L. duloticus* enslaves *longispinosus* and *curvispinosus* and conducts its raids very much in the fashion of Harpagoxenus (which see). Wesson's observations on the slave raids of *duloticus* were made in an artificial nest and, while they demonstrate that the insect is dulotic, they scarcely permit the drawing of fine distinctions between the raids of *duloticus* and those of Harpagoxenus. We need additional field data on the habits of *duloticus*.

The following key does not contain Smith's *minutissimus*. This species is known only from the female. I have also omitted *foveata* M. R. Smith and *pinetorum* L. G. & R. G. Wesson, for reasons discussed under the species *ambiguus*.

Key to the species of Leptothorax

1. Petiole and postpetiole armed with spine-like protuberances; humeri of the pronotum distinctly angular (Subgenus *Goniothorax*) ..... *wilda*
   Petiole and postpetiole without spine-like protuberances; humeri of the pronotum rounded or indistinctly angular 2
2. Antennae twelve jointed 3
   Antennae eleven jointed 20
3. Antennal scapes surpassing the occipital margin; dorsum of the promesonotum strongly convex in profile; mesoepinotal suture profoundly impressed (Subgenus *Dichothorax*) 4
   Antennal scapes not surpassing the occipital margin; dorsum of the promesonotum flat or feebly convex in profile; mesoepinotal suture at most with a shallow impression 5
4. Node of the petiole, seen in profile, low and angular, seen from behind the crest of the node is flat or with a shallow concave impression; color piceous brown ..... *pergandei*
   Node of the petiole, seen in profile, with a blunt and rounded crest, seen from behind the crest of the node is slightly convex; color variable, piceous brown to yellow ..... *pergandei* subsp. *floridanus*
5. Base of the first gastric segment reticulo-punctate ..... *silvestrii*
   Base of the first gastric segment smooth and shining 6
6. Dorsum of the thorax very smooth and highly shining, entirely devoid of sculpture except for small and widely spaced piligerous punctures ..... *schmitti*
   Dorsum of the thorax variously sculptured, never entirely smooth and shining 7
7. Dorsum of the postpetiole coarsely reticulo-rugose ..... *texanus*
   Dorsum of the postpetiole punctate or granulose but not reticulo-rugose; rugae, if present, longitudinal and confined to the sides of the node 8
8. Posterior half of the head in large part smooth and shining with a broad central strip which is free from sculpture extending forward to the antennal lobes 9
   Head largely or entirely sculptured, the surface feebly shining or completely opaque 10
9. The antennal scape in repose failing to reach the occipital margin by an amount not exceeding its greatest thickness ..... *nitens*
   The antennal scape in repose failing to reach the occipital margin by an amount at least twice as great as its greatest thickness ..... *nitens* subsp. *heathi*
10. Head densely and evenly punctate, the punctures not interspersed with striae or rugae, the surface completely opaque; color pale yellow ..... *terrigena*
    Head with striae or rugae as well as punctures, the surface usually feebly shining; color brownish yellow to dark brown 11
11. Epinotal spines joined at their base by a distinct transverse ridge or welt which lies at the angle between the basal and declivious faces of the

epinotum ..... *obturator*
Epinotal spines not joined at the base by a transverse welt 12

12. Dorsum of the thorax densely and evenly punctate, rugae if present very feeble; sides of the thorax with heavy punctures which largely obscure the rugae 13
Dorsum of the thorax with the punctures interrupted by prominent rugae on the epinotum and mesonotum and often on the pronotum as well; rugae on the sides of the thorax not obscured by punctures 16

13. The antennal scape in repose failing to reach the occipital margin by an amount twice as great as its greatest thickness; epinotal spines reduced to short, stumpy angles ..... *andrei*
The antennal scape in repose failing to reach the occipital margin by an amount no greater than its greatest thickness; epinotal spines well-developed 14

14. Sides of the petiole punctate only 15
Sides of the petiole with rugae as well as dense punctures ..... *nevadensis* subsp. *melanderi*

15. Head (mandibles excluded) one-sixth longer than broad ..... *nevadensis*
Head (mandibles excluded) not more than one-eighth longer than broad *nevadensis* subsp. *eldoradensis*

16. Node of the petiole with feeble rugae (in addition to the dense punctures) which do not break the even outline of the node ..... *furunculus*
Node of the petiole with very coarse rugae which give a rough outline to the node 17

17. Postpetiole very voluminous, approximately twice as wide as the node of the petiole and half as wide as the gaster ..... *texanus* subsp. *davisi*
Postpetiole not twice as wide as the petiole and at most not more than one-third as wide as the gaster 18

18. Dorsum of the thorax completely covered with coarse, longitudinal rugae except for a small, heavily punctured area on the mesonotum ..... *nevadensis* subsp. *rudis*
Rugae on the dorsum of the thorax largely confined to the epinotum and the rear of the mesonotum, the anterior portion of the thorax punctate only 19

19. Epinotal spines short; the thoracic dorsum feebly shining ..... *tricarinatus*
Epinotal spines longer; the thoracic dorsum largely opaque ..... *tricarinatus* subsp. *neomexicanus*

20. Dorsum of the postpetiole shining, the sculpture consisting of widely spaced, small punctures with the surface between them smooth or delicately shagreened 21
Dorsum of the postpetiole opaque or nearly so, the surface densely punctate or punctato-granulose 22

21. Hairs of the scape fully erect; interrugal sculpture of the head heavy enough to dull the surface which is feebly shining ..... *provancheri*
Hairs of the scape reclinate; interrugal sculpture of the head more feeble, the surface moderately shining ..... *provancheri* subsp. *glacialis*

22. Antennal scapes with moderately abundant, erect hairs present on all

surfaces 23
Antennal scapes with the hairs fully appressed or at most with a few suberect hairs confined to the anterior surface of the scape 24

23. Erect hairs on the antennal scapes short, stout and blunt; color orange yellow ..... *hirticornis*
Erect hairs on the antennal scapes long, slender and pointed; color reddish yellow ..... *diversipilosus*

24. Clypeus with a median carinula or with several carinulae; mesoepinotal suture seldom present on the thoracic dorsum and never impressed ... 29
Clypeus without a median carinula, its center usually depressed to form a shallow, longitudinal trough; mesoepintoal suture regularly present on the thoracic dorsum and usually depressed slightly below the level of the rest of the thorax 25

25. Erect body hairs numerous, long and usually pointed; interrugal punctures on the thorax heavy and dense, the surface feebly shining or opaque *crassipilis*
Erect body hairs sparse, short and usually clavate; interrugal punctures on the thorax shallow and rather sparse, the surface where they occur moderately shining 26

26. Antennal scapes with a few suberect hairs on their anterior surfaces .... *canadensis* subsp. *kincaidi*
Antennal scapes with all hairs closely appressed 27

27. The thoracic dorsum with distinct reticulo-rugose sculpture in addition to the dense punctures 28
The thoracic dorsum densely punctate but with the rugae very feeble or absent ..... *canadensis* subsp. *yankee*

28. Color piceous brown, the thorax very rarely lighter than the head and gaster; mesonotal rugae less prominent than those of the pronotum and often largely replaced by punctures ..... *canadensis*
Head and gaster notably darker than the thorax, the latter usually reddish yellow in color; mesonotum usually crossed by prominent rugae .... *canadensis* subsp. *calderoni*

29. Epinotal spines longer than one-half the distance which separates their bases 30
Epinotal spines short and dentiform, their length less than one-half the distance which separates their bases ..... *schaumi*

30. Dorsal surface of the head in large part strongly shining, the longitudinal rugae, if present, sparse and feeble, the interrugal sculpture consisting of small widely-scattered punctures ..... *longispinosus*
Dorsal surface of the head feebly shining or completely opaque, the sculpture variable but never of a character to give the surface a smooth and strongly shining appearance 31

31. Head with the longitudinal rugae very delicate, not much coarser than the interrugal sculpture and often forming reticulations with it 32
Head with coarse longitudinal rugae which are notably heavier than the interrugal sculpture and do not form reticulations with it 34

32. The antennal scape in repose reaching the occipital margin .... *duloticus*

The antennal scape in repose failing to reach the occipital margin by an amount approximately equal to the length of the first funicular joint. . 33

33. Epinotal spines set close together at the base; postpetiole, seen from above, subquadrate, very little broader than long. . . . . *curvispinosus*
Epinotal spines well-separated at the base; postpetiole, seen from above, notably broader than long. . . . . *ambiguus*

34. Interrugal punctures of the head very dense and coarse, the areas where they occur dull. 35
Interrugal punctures of the head fine and somewhat separated, the areas where they occur feebly shining. 36

35. Dorsum of the postpetiole lightly punctured, not completely opaque; dorsum of the mesonotum with the longitudinal rugae largely replaced by punctures; epinotal spines less than half as long as the distance which separates their tips. . . . . *bradleyi*
Dorsum of the postpetiole heavily punctured and completely opaque; dorsum of the mesonotum with the longitudinal rugae not replaced by punctures; epinotal spines more than half as long as the distance which separates their tips. . . . . *wheeleri*

36. Thoracic rugae well-developed. . . . . *rugatulus*
Thoracic rugae feeble, often replaced in part by punctures. . . . . *rugatulus* subsp. *brunnescens*

Subgenus GONIOTHORAX Emery

1. LEPTOTHORAX (GONIOTHORAX) WILDA M. R. Smith

L. (*G.*) *wilda* M. R. Smith, Proc. Ent. Soc. Wash., Vol. 45, p. 155 (1943) ♀ ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 572, pl. 11, fig. 42 (1947) ♀.

Type loc: Brownsville, Texas. Type: U.S.N.M. Paratypes: U.S.N.M., M.C.Z., A.M.N.H., Coll. Cal. Acad. Sci.

Range: known from southern Texas only.

This interesting species is the first member of the subgenus to be taken within our borders. It apparently nests in hollow twigs or the stems of vines.

Subgenus DICHOTHORAX Emery

The status of the forms which compose this subgenus is very puzzling. Since only five representatives have been described there would seem to be little chance for taxonomic confusion. Unfortunately this is not the case. These insects are highly variable in such traits as color, hair pattern and sculpture. Since such variations often appear within a nest series it is very difficult to select subspecific char-

acters which are constant enough to give good separation. Added to this minor structural variation is a distribution which argues against subspecific status for most of the forms. The ranges are so nearly coincidental that no geographical distinction is practical in several cases. Because of the above considerations I find it difficult to attach much taxonomic significance to the varieties *flavus* and *spinosus*, which seem best regarded as inconstant fluctuations which occur in the population of *floridanus*. Wesson has reached a similar conclusion for the species which he described in 1935 as *manni*. He now regards this insect as a synonym of *pergandei*. This leaves only *pergandei* and *floridanus*. I have attempted to treat the latter form as a subspecies of *pergandei*, for the two are so similar structurally that it is unlikely that they represent separate species. But this treatment runs afoul of the fact that the two forms have ranges which overlap broadly in the region running westward from North Carolina to Oklahoma. It appears, however, that the range of *pergandei* extends further to the north than does that of *floridanus* and the latter insect has a southern and southwestern range which is separate from that of *pergandei*. It would not be surprising, however, if future investigations show that it is not possible to separate *pergandei* and *floridanus*.

2. Leptothorax (Dichothorax) pergandei Emery

L. (*D.*) *pergandei* Emery, Zool. Jahrb. Syst., Vol. 8, p. 323, pl. 8, fig. 13 (1895) ♀ ♀ ♂; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 256, pl. 12, fig. 23 (1903) ♀ ♀ ♂.

L. (*D.*) *manni* Wesson, Ent. News, Vol. 46, p. 208 (1935) ♀ ♀ ♂.

L. (*D.*) *manni* Wesson, Ent. News, Vol. 50, p. 180 (1939) (synonymic note).

Type loc: Washington, D.C. Types: A.M.N.H., M.C.Z.

Range: rather sporadically distributed in the central Atlantic states south to Tennessee and North Carolina and west to Indiana.

3. Leptothorax (Dichothorax) pergandei floridanus Emery

L. (*D.*) *floridanus* Emery, Zool. Jahrb. Syst., Vol. 8, p. 324 (1895) ♀; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 259 (1903) ♀.

L. (*D.*) *pergandei* var. *flavus* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 22, p. 549 (1929) ♀ ♀.

L. (*D.*) *pergandei* subsp. *floridanus* var. *spinosus* M. R. Smith, Ibid., p. 551 (1929) ♀.

L. (*Dichothorax*) sp. M. R. Smith, Amer. Mid. Naturalist, Vol. 27, No. 3, p. 574, pl. 12, fig. 44 (1947) ♀.

Type loc: Florida. Types: A.M.N.H.

Range: North Carolina to Florida and southwestward into Texas.

Subgenus LEPTOTHORAX Mayr

4. LEPTOTHORAX AMBIGUUS Emery

The taxonomic status of *ambiguus* has been confused from the start, since Emery treated this insect as a subspecies of *curvispinosus* at the time of its original description in 1895. It was not until 1940 that this situation was corrected. At that time the Wessons proposed specific status for *ambiguus* and redescribed the insect. The Wessons presented an excellent list of structural differences which distinguish *ambiguus* from *curvispinosus*. While these were quite adequate to establish *ambiguus* as a separate species, it seems well to add certain other points which have a bearing on the specificity of *ambiguus*. On the basis of distribution the relationship of *ambiguus* to *curvispinosus* is clearly that of a species, not a subspecies. Over a considerable part of the northeastern United States the two insects occur in the same stations with the nests often occurring within a few feet of each other. Despite this proximity there is no evidence that the two intergrade. In addition, the habits of the two species show certain significant differences. *L. curvispinosus* nests by preference in preformed cavities, especially those which occur in various plant tissues. The objects in which the nests are constructed either rest on the surface of the soil or are suspended above it. It is only rarely that a nest of *curvispinosus* is found with passages in the soil itself. The nests of *ambiguus* may also be constructed in plant cavities but those selected usually involve a much more intimate relation with soil. Thus the Wessons report *ambiguus* nesting in the hollow stems at the base of grass tufts or free in the soil. The writer has always found *ambiguus* nesting in soil. Finally, there is indirect evidence to show that *ambiguus* is a more pugnacious ant than *curvispinosus*. I believe that I am correct in stating that as yet no record of the enslavement of *ambiguus* by Harpagoxenus has been reported. Since Harpagoxenus enslaves both *longispinosus* and *curvispinosus*, there would seem to be no reason why it should not also enslave *ambiguus* unless the last species is sufficiently enterprising to beat off the raids.

Before presenting the citations for *ambiguus*, it is necessary to consider the status of two forms which are closely related to it. Dr. M. R. Smith now regards the insect which he described as the species *foveata* in 1934 as very closely related to *ambiguus* if not actually a synonym of that species. In 1940 the Wessons recognized a variety of *ambiguus* to which they gave the name *pinetorum*. The principal differences between *foveata* and *ambiguus* are to be found in the more robust petiolar nodes and a slightly stronger impression of the sides

of the thorax at the mesoepinotal suture in *foveata*. According to the Wessons, the epinotal spines of *pinetorum* are notably longer than those of *ambiguus* and the thoracic rugae of *pinetorum* are feebler. In both cases the differences are clearly discernible only when the variants can be compared with the typical form. For this reason I have made no attempt to include either *foveata* or *pinetorum* in the key. The problem of distinguishing between these variants and the typical *ambiguus* is by no means the only difficulty involved. We know practically nothing about the range of either insect. The two type specimens of *foveata* were taken at Plainfield, Illinois. The type series of *pinetorum* and several other nests of this form came from Jackson County, Ohio. Since it has been customary to regard the range of the typical *ambiguus* as extending from eastern Canada and New England to the Dakotas, there is little present help to be secured from the occurrence of both *foveata* and *pinetorum* at points approximately in the middle of this range. But it is by no means certain that the population which has previously been regarded as the typical *ambiguus* is a uniform one. It may be recalled that Emery utilized material coming from South Dakota, Ohio and New York as type specimens of *ambiguus*. In order to reduce confusion which might arise from a mixed type series, I propose to restrict the type series of *ambiguus* to those specimens which were taken in Hill City, South Dakota. There are two reasons why this is advantageous. Specimens from this same series, which are authentic and presumably cotypes, are present in three American museums. In the second place, if there is any tendency for *ambiguus* to produce geographical races, it may be safely assumed that the Hill City specimens represent the western race, for this station appears to be close to the western limit of the range of the species. Before anything certain can be stated as to the exact relationship of *foveata* and *pinetorum* to the typical *ambiguus* it will be necessary to make a survey of the eastern population of *ambiguus* and determine to which of the three described forms this population belongs. Either *foveata* or *pinetorum* may prove to be an eastern race of the typical *ambiguus*. I confess that it seems very unlikely that both will prove to be valid subspecies and perhaps both may prove to be inconsequential variations which lack any distributional significance. Until the matter can be definitely decided the two forms may be retained provisionally as subspecies. There follows the synonymy of *Leptothorax ambiguus* Emery:

L. curvispinosus subsp. *ambiguus* Emery, Zool. Jahrb. Syst., Vol. 8, p. 320 (1895) ♀; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 241, pl. 12, fig. 11 (1903) ♀.

L. ambiguus L. G. & R. G. Wesson, Amer. Mid. Naturalist, Vol. 24, No. 1, p. 97 (1940) ♀ ♀ ♂.
Type loc: Hill City, South Dakota (by present restriction). Types: A.M.N.H., M.C.Z., U.S.N.M.
Range: eastern Canada and New England west to the Dakotas. In the east the southern limit of the range seems to lie at the latitude of Pennsylvania and Ohio.

5. Leptothorax ambiguus foveatus M. R. Smith

L. foveata M. R. Smith, Psyche, Vol. 41, p. 211 (1934) ♀.
Type loc: Plainfield, Illinois. Types: Coll. M. R. Smith.
Range: known only from type material.

For a discussion of the relationships of *foveatus* to *ambiguus* see the introduction to *ambiguus*.

6. Leptothorax ambiguus pinetorum L. G. & R. G. Wesson

L. ambiguus subsp. *pinetorum* L. G. & R. G. Wesson, Amer. Mid. Naturalist, Vol. 24, No. 1, p. 97 (1940) ♀ ♀ ♂.
Type loc: Jackson County, Ohio. Types: Coll. Wessons.
Range: known only from Jackson County, Ohio.

For a discussion of the relationships of *pinetorum* to *ambiguus* see the introduction to *ambiguus*.

7. Leptothorax andrei Emery

L. andrei Emery, Zool. Jahrb. Syst., Vol. 8, pl. 8, fig. 15 (1895) ♀; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 256 (1903) ♀.
Type loc: California. Types: none in this country.
Range: known only from the coastal area of central California.

8. Leptothorax bradleyi Wheeler

L. bradleyi Wheeler, Psyche, Vol. 20, p. 113 (1913) ♀.
Type loc: Billy's Island, Okefenokee Swamp, Georgia. Type: A.M.N.H.
Range: known only from the single holotype.

9. Leptothorax curvispinosus Mayr

L. curvispinosus Mayr, Sitz-ber. Acad. Wiss. Wien, Vol. 53, p. 508, pl. 1, fig. 13 (1866) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 451 (1886)

☿ ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 317 (1895); Wheeler, Proc. Acad. Nat. Sci. Phila., p. 329, pl. 12, fig. 10 (1903) ☿ ♀.

Stenamma gallarum Patton, Amer. Naturalist, Vol. 13, p. 126, note (1879) ☿ ♀.

Type loc: 'North America'. Types: none in this country.

Range: New England west to Iowa and Missouri and south to the Gulf Coast. In Mississippi and Alabama the insect is abundant only in the northern portions of the states. It is rare in the coastal area, although I have taken a few colonies as far south as Mobile.

10. Leptothorax furunculus Wheeler

L. furunculus Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 82 (1909) ☿.

Type loc: Williams Canyon, Manitou, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: known only from type material.

11. Leptothorax longispinosus Roger

L. longispinosus Roger, Berl. Ent. Zeitschr., Vol. 7, p. 180 (1863) ☿; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 451 (1886) ☿; Emery, Zool. Jahrb. Syst., Vol. 8, p. 321 (1895) ☿ ♀; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 236, pl. 12, fig. 9 (1903) ☿ ♀ ♂.

L. (*L.*) *longispinosus* subsp. *laeviceps* Buren, Iowa State Coll. Jour. Sci., Vol. 18, No. 3, p. 287 (1944) ☿ (*nec* Emery).

L. (*L.*) *longispinosus* subsp. *iowensis* Buren, Proc. Ent. Soc. Wash., Vol. 47, p. 288 (1945).

Type loc: 'America'. Types: none in this country.

Range: eastern Canada and the northeastern United States west to Iowa. In the central Atlantic states the range follows the Appalachians and terminates in northern Georgia and northeastern Alabama.

The writer can see little justification for the recognition of Buren's subsp. *iowensis*. This insect was originally described under the preoccupied name, *laeviceps*. According to Mr. Buren, *iowensis* is a western race of *longispinosus*. It may be admitted that the presence of *iowensis* at the western end of the range of *longispinosus* favors such an interpretation. Unfortunately, this view is not supported by distributional data. Although Mr. Buren presented a number of features by which *iowensis* may be separated from the typical *longispinosus*, these differences do not, in my opinion, have a distributional significance. The single paratype of *iowensis* which Mr. Buren very kindly sent me differs in no way from the smaller and more lightly sculptured specimens which occur over the whole range of *longispinosus*. For this reason it is impossible to regard *iowensis* as a western

race and, since it seems to be nothing more than one of the minor fluctuations which occur within the population of *longispinosus*, it is best regarded as a synonym of the typical form.

12. Leptothorax minutissimus M. R. Smith

L. minutissimus M. R. Smith, Proc. Ent. Soc. Wash., Vol. 44, p. 59, pl. 6, figs. A, B (1942) ♀.
Type loc: District of Columbia. Holotype and Paratypes: U.S.N.M.
Range: known from type material only.

The exact relationships of *minutissimus* are very puzzling. Dr. Smith is of the opinion that it may be a parasite on *L. curvispinosus*. The type series of *minutissimus*, consisting of several females, was associated with *curvispinosus* workers, although it is not certain that the two species came from the same nest. *L. minutissimus* is smaller than the female of *curvispinosus* and has a distinctly emarginate occipital border.

13. Leptothorax nitens Emery

L. nitens Emery, Zool. Jahrb. Syst., Vol. 8, p. 323, pl. 8, fig. 16 (1895) ♀; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 244, pl. 12, fig. 15 (1903) ♀.
L. nitens var. *mariposa* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 507 (1917) ♀.
L. nitens subsp. *occidentalis* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 245 (1903) ♀.
Type loc: American Fork Canyon, Utah. Types: none in this country.
Range: Utah and Colorado west to the Sierras of California.

After examining the type material of the three variants which Wheeler allotted to *nitens*, I am of the opinion that only *heathi* is a valid subspecies. Fluctuations of color and variation in the coarseness of the thoracic punctures occur in the type series of both *mariposa* and *occidentalis* and I do not believe that these characteristics, which formed the basis for the recognition of the two variants, are sufficiently constant to be of taxonomic value. The subspecies *heathi*, on the other hand, is clearly distinguished by its short antennal scapes. It is, as Wheeler noted, unusually dark as well.

14. Leptothorax nitens heathi Wheeler

L. nitens var. *heathi* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 245 (1903) ♀.
Type loc: Pacific Grove, California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: known only from type material. This seems to be a lowland subspecies. The typical *nitens* also occurs in California but is restricted to areas of considerable elevation in the Sierras.

15. Leptothorax nevadensis Wheeler

L. nevadensis Wheeler, Proc. Acad. Nat. Sci. Phila., p. 252, pl. 12, fig. 20 (1903) ☿ ♀ ♂.
Type loc: Kings Canyon, Ormsby County, Nevada. Types: A.M.N.H., M.C.Z.
Range: eastern slopes of the Sierras from Lake Tahoe north to the Cascade Mountains of Washington.

With the addition of more specimens it has been possible to show that Wheeler's species *eldoradensis* and *melanderi* are subspecies of *nevadensis*. Specimens coming from Sequoia National Park are obviously intergrades between *rudis* and *eldoradensis* and others from eastern Washington connect *melanderi* and the typical *nevadensis*. As yet no intergrades between *nevadensis* and *rudis* have been reported, but these must certainly occur, as the ranges of the two forms overlap in the region around Lake Tahoe.

16. Leptothorax nevadensis eldoradensis Wheeler

L. eldoradensis Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 414 (1915) ☿.
Type loc: Mt. Wilson, Pasadena, California. Types: M.C.Z.
Range: Coastal Range and at lower elevations in the Sierras of California.

17. Leptothorax nevadensis melanderi Wheeler

L. melanderi Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 81 (1909) ☿.
Type loc: Moscow Mountains, Idaho. Types: A.M.N.H.
Range: eastern Washington to western Montana.

18. Leptothorax nevadensis rudis Wheeler

L. nevadensis subsp. *rudis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 508 (1917) ☿ ♀.
Type loc: Tenaya Canyon, Yosemite Valley, California. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: Sierras of California from Sequoia Park to Lake Tahoe.

19. Leptothorax obturator Wheeler

L. obturator Wheeler, Proc. Acad. Nat. Sci. Phila., p. 242, pl. 12, fig. 19 (1903) ♀ ♀ ♂.
Type loc: Austin, Texas. Types: A.M.N.H., M.C.Z.
Range: known from type material only.

20. Leptothorax rugatulus Emery

The taxonomic history of *rugatulus* is rather depressing. A lack of appreciation for certain characteristics of the typical form has resulted in the description of several subspecies and varieties most of which are invalid. I have examined a very large amount of material of *rugatulus* coming from ten western states. In this material were included types of all but one of the described forms. In addition, I have repeatedly studied this insect in the field. As a result, I am convinced that there are only two valid forms present, the typical *rugatulus* and the subspecies *brunnescens*. The color of these insects is highly responsive to environmental conditions. When the nests are situated in dry, sunny areas the workers will show little or no infuscation. Conversely, a shaded nest, or one in rather moist soil, is usually inhabited by dark workers. There is no evidence to show that these color phases have a distributional significance. It may be admitted that the population in the California Sierras averages darker than that in the Rockies but the full color range is present in both areas. The same consideration will apply to the color of the female. Wheeler was of the opinion that the variety *mediorufus* was distinguished by a large and very dark female. I have taken such large, dark females from nests in which the workers were almost without infuscation. The typical *rugatulus* also shows many slight variations in sculpture. These do not alter the basic pattern, which consists of rugae interspersed with punctures, but the abundance of the interrugal punctures, especially those on the head is rather variable, with the result that some specimens are more shining than others. Here again there is no evidence that such variation can be correlated with distribution. I have yet to see a nest series which is entirely constant in sculpture throughout.

It may be appreciated, however, that one might be misled by such fluctuations if only a small amount of material were available for examination. This has been the case with Wheeler's *cockerelli, annectens* and *mediorufus*, all of which must be regarded as synonyms of the typical *rugatulus*. Wheeler's *brunnescens*, on the other hand, shows constant and significant structural differences and a preference for

nest sites at a high elevation which separates its range from that of *rugatulus*. The thoracic rugae of *brunnescens* are largely obliterated by the punctures and the cephalic rugae are feeble. While the cephalic sculpture of the typical *rugatulus* often approaches that of *brunnescens* closely, these more lightly sculptured specimens of *rugatulus* always retain the thoracic rugae. The difference in appearance is very striking.

The subspecies *dakotensis*, described by G. C. and E. W. Wheeler in 1944, is so certainly a synonym of *brunnescens* that I have little hesitation in synonymizing *dakotensis*, even though I have not seen type material of this form. The line by line agreement of G. C. and E. W. Wheeler's description of *dakotensis* with that of W. M. Wheeler's description of *brunnescens* is startling except for one difference. W. M. Wheeler described the postpetiole of *brunnescens* as being twice as wide as long, while G. C. and E. W. Wheeler described the postpetiole of *dakotensis* as one and one-quarter times as broad as long. A distinction of this magnitude requires more than passing comment. I believe, however, that the difference is more a matter of terminology than of structure. Unless I am very much mistaken, W. M. Wheeler excluded the anterior and posterior peduncles in making his estimate, hence the proportions which he presented apply to the node of the postpetiole only. Conversely, the proportions cited by G. C. and E. W. Wheeler clearly include the anterior and posterior peduncles. In an effort to check this matter I made micrometer measurements of the postpetiole of the types of *brunnescens* and also of specimens which Wheeler considered as the typical *rugatulus*. In both insects the proportions of the node of the postpetiole agreed very closely with the figures cited by W. M. Wheeler. The width of the node is almost exactly twice its length and this proportion holds regardless of slight size differences in the worker. If, however, one included the anterior and posterior peduncles, the proportions were more in line with those cited by G. C. and E. W. Wheeler. It may be recalled that G. C. and E. W. Wheeler consider the postpetiole of the typical *rugatulus* to be one and one-half times as broad as long. Since they state that the postpetiole of *dakotensis* is only one-sixth narrower than that of the typical *rugatulus*, it seems certain that the postpetiole of *dakotensis* is not unusually narrow and that there is no great difference between the postpetiole of *dakotensis* and that of *brunnescens*. I feel certain that when the types of *dakotensis* can be compared with those of *brunnescens*, the two insects will prove to be identical. There follows the synonymy of *Leptothorax rugatulus* Emery:

L. rugatulus Emery, Zool. Jahrb. Syst., Vol. 8, p. 321 (1895) ♀; Wheeler, Proc. Amer. Acad. Arts. Sci. Boston, Vol. 52, p. 509 (1917).

L. curvispinosus subsp. *rugatulus* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 241, pl. 12, fig. 12 (1903) ♀.
L. curvispinosus subsp. *annectens* Wheeler, Ibid., p. 242, pl. 12, fig. 13 (1903) ♀.
L. rugatulus var. *cockerelli* Wheeler, Ibid., p. 241 (1903) ♀ ♀.
L. rugatulus var. *mediorufus* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 510 (1917) ♀ ♀.
Type loc: Colorado (by present restriction). Types: A.M.N.H.
Range: widely distributed throughout the Transition Zone in the Rocky Mountains, the Sierras and Cascades and the mountains of Arizona and Utah. An eastward extension of the range brings the insect into the Black Hills of South Dakota. The elevation at which *rugatulus* nests varies with the latitude but even in southern Arizona it does not nest above 7000 feet.

21. Leptothorax rugatulus brunnescens Wheeler

L. rugatulus subsp. *brunnescens* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 510 (1917) ♀.
L. rugatulus subsp. *dakotensis* G. C. & E. W. Wheeler, North Dakota Historical Quarterly, Vol. 11, No. 4, p. 247 (1944) ♀.
Type loc: Creede, Colorado. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: mountains of Colorado and Utah north to Montana and the Dakotas. In central Colorado the insect occurs at elevations of 8000 feet or more but descends to lower levels further north.

It is possible to regard *brunnescens* as a subspecies of *rugatulus* since the ranges of the two are separated by elevation. However, there is less evidence of intergradation than might be expected and further investigation may show that *brunnescens* should be regarded as a separate species. The reasons for placing the subspecies *dakotensis* in the synonymy of *brunnescens* have been given in the introduction to *rugatulus*.

22. Leptothorax schaumi Roger

In the present work *fortinodis* and its two varieties, *melanoticus* and *gilvus*, have been synonymized with *schaumi*. This treatment agrees in its principal point with the observations published by L. G. and R. G. Wesson in 1940. Neither the Wessons nor the writer believe that *fortinodis* is specifically distinct from *schaumi*. The Wessons' contribution to the *schaumi-fortinodis* problem will be subsequently considered but first it seems advisable to review the steps by which the problem arose.

Roger first described *schaumi* in 1863. No further mention was made of this insect until 1886. In that year Mayr described a second

species, *fortinodis*, and presented a key which gave characteristics by which *schaumi* and *fortinodis* could be separated. The major distinction which Mayr employed was that of color. The color of *schaumi* was given as reddish gold, that of *fortinodis* as brownish black. Even so, Mayr noted that he had seen one variety in which the head, thorax and petiole were reddish brown. As may be seen from the name which Mayr selected for his new species, he believed that it possessed a somewhat larger and thicker petiole than *schaumi*. But this structural difference was subordinated to the much more apparent color difference, and when Emery published his *Beiträge* in 1895 he threw over the petiolar difference and relied on color entirely to secure separation between *schaumi* and *fortinodis*. His judgment has since been proven absolutely sound. Wheeler's 1903 monograph of Leptothorax based the separation of the two insects on petiolar structure. Wheeler found himself forced to abandon color as a specific distinction because he had discovered a pale variant of *fortinodis* which he called *gilvus*. The character of the type series of *gilvus* is worthy of note. It consisted of a deälated female and seven workers. The female and two of the workers were pure yellow in color. The remaining five workers were dark brown. They were, according to Wheeler, 'like the workers of the typical *fortinodis*'. If this were not enough to suggest that the two insects are cospecific, Wheeler supplied additional evidence in the closing paragraph of his description of *gilvus*. Here Wheeler stated that the 'Austin specimens of *fortinodis*' as well as the types of *melanoticus* and *gilvus* all have smaller petioles than Mayr's type of *fortinodis* and 'suggest transitions to *schaumi*'. Wheeler avoided the difficulty resulting from the mixed worker caste in the type nest of *gilvus* by a manœuver which appears to be unique in myrmecological taxonomy. Although he admitted that all the workers were offspring of the yellow female and postulated that the color differences which they showed were due to the fact that the yellow female had mated with a normal black male of *fortinodis*, Wheeler avoided the obvious issue of cospecificity by restricting the type of *gilvus* to the female only. He was thus able to continue the older practice of treating *schaumi* and *fortinodis* as separate species.

Since 1903 there has been a steady accumulation of evidence to show that 'mixed' colonies containing both black and yellow workers are by no means rare. The first careful analysis of such colonies was presented by the Wessons in 1940. They were able to give much valuable data derived from a study of eight mixed colonies which they took in Ohio. In these colonies there appeared to be no correlation between the color of the worker and the character of the petiole. While the colors showed no tendency to intergrade, minor structural

features varied and intergraded to a very large extent. The Wessons, therefore, concluded that if there was to be any separation between *schaumi* and *fortinodis* it would have to be on the basis of color alone. They pointed out that this color difference was not of sufficient significance to allow its use as the basis for separate specificity in the case of *fortinodis*. They proposed, therefore, to reduce *fortinodis* and *melanoticus* to a single color variety of *schaumi*. They left *gilvus* strictly alone which, for reasons that have been given above, is about all that can be done with that extraordinary variety. The writer finds himself in complete agreement with the Wessons in this matter with the exception of using *fortinodis* as a varietal name. I have shown elsewhere that there is no justification for the use of formal names to describe the color phases of ants. It will cause no confusion if the light and dark phases of *schaumi* are referred to as such. I have, therefore, treated *fortinodis*, *melanoticus* and *gilvus* as synonyms of *schaumi*. There follows the synonymy of *Leptothorax schaumi* Roger:

L. schaumi Roger, Berl. Ent. Zeitschr., Vol. 7, p. 180 (1863) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 451 (1886) ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 8, p. 320 (1895) ♀; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 232, pl. 12, fig. 7 (1903) ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 574, pl. 12, fig. 43 (1947) ♀.

L. fortinodis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 452 (1886) ♀ ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 318 (1895); Wheeler, Proc. Acad. Nat. Sci. Phila., p. 233, pl. 12, fig. 8 (1903) ♀ ♀.

L. fortinodis var. *gilvus* Wheeler, Ibid., p. 235 (1903) ♀.

L. fortinodis var. *melanoticus* Wheeler, Ibid., p. 235 (1903) ♀ ♀.

Type loc: Pennsylvania. Types: none in this country.

Range: New England west to Iowa and southwest to Texas. The insect appears to be fairly abundant in the eastern United States and as far south as South Carolina, but is rare in the eastern Gulf States and apparently absent in Florida.

23. Leptothorax schmitti Wheeler

L. schmitti Wheeler, Proc. Acad. Nat. Sci. Phila., p. 242, pl. 12, fig. 14 (1903) ♀.

Type loc: Canyon City, Colorado. Types: A.M.N.H., M.C.Z.

Range: known only from type material.

24. Leptothorax silvestrii (Santschi)

Tetramorium silvestrii Santschi, Bull. Soc. Ent. Ital., Vol. 41, p. 6 (1909) ♀.

L. silvestrii Emery, in Wystman, *Genera Insectorum*, Fasc. 174, p. 258 (1922).

Type loc: Tucson, Arizona. Types: none in this country.

Range: known only from type material.

The fact that *silvestrii* was described by Santschi as a Tetramorium and later shifted by Emery to Leptothorax has made the generic affinities of this species questionable. Dr. M. R. Smith, with whom I have discussed this problem, is of the opinion that *silvestrii* should be treated as a doubtful species whose generic character cannot at present be determined. There is much to be said for this view but it leaves out of account the fact that Emery, whose caution in such matters was exemplary, had ample opportunity to ascertain the nature of *silvestrii* before he made the generic reallocation. In 1909 Santschi had scarcely more than begun his myrmecological studies and was in close touch with both Forel and Emery. It is, therefore, entirely probable that Emery received authentic material of *silvestrii* from Santschi. Indeed, it is almost necessary to assume that this was the case, for there is little in Santschi's original description of *silvestrii* to indicate a relationship with the genus Leptothorax. Until the types of *silvestrii* can be re-examined, it seems preferable to trust Emery's judgement and to retain *silvestrii* in the genus Leptothorax.

25. Leptothorax terrigena Wheeler

L. terrigena Wheeler, Proc. Acad. Nat. Sci. Phila., p. 254, pl. 12, fig. 21 (1903) ♀ ♀.

Type loc: Austin, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: known from type material only.

26. Leptothorax texanus Wheeler

L. texanus Wheeler, Proc. Acad. Nat. Hist. Phila., p. 245, pl. 12, fig. 16 (1903) ♀ ♀ ♂.

Type loc: Milano, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: central Texas to southern Ohio.

Gregg (1946) has recorded this species from northeastern Minnesota. The record, which was based on a single worker, is rather more than suspect. It is scarcely credible that *texanus*, whose range west of the Mississippi lies mainly below the northern border of Oklahoma, should occur in Minnesota. As to what species Dr. Gregg had is questionable but it seems clear that it was not *texanus*.

27. Leptothorax texanus davisi Wheeler

L. texanus subsp. *davisi* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 385 (1905) ♀ ♀.

Type loc: Lakehurst, New Jersey. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: pine barrens of New Jersey. The insect has also been taken on Long Island.

There are so many striking structural differences which separate *davisi* from *texanus* that *davisi* could easily be regarded as a separate species. The question cannot be settled until we know more about the range of *davisi*. At present *davisi* is not known to occur south or west of New Jersey. There is, therefore, a considerable gap between its range and that of *texanus*. Additional field work may close this gap and we will then be in a position to evaluate the relationship of *davisi* to *texanus*.

28. Leptothorax tricarinatus Emery

L. tricarinatus Emery, Zool. Jahrb. Syst., Vol. 8, p. 321, pl. 8, fig. 14 (1895) ♀; Wheeler, Proc. Acad. Nat. Sci., Phila., p. 247, pl. 12, fig. 17 (1903) ♀.
Type loc: Hill City, South Dakota. Types: none in this country.
Range: western South Dakota to central Iowa.

29. Leptothorax tricarinatus neomexicanus Wheeler

L. neomexicanus Wheeler, Proc. Acad. Nat. Sci. Phila., p. 248, pl. 12, fig. 18 (1903) ♀.
Type loc: Manzanares, New Mexico. Types: A.M.N.H., M.C.Z.
Range: northern New Mexico and Arizona.

Wheeler regarded *neomexicanus* as a separate species but I believe that it is at most a southern race of *tricarinatus*. To judge from Emery's description of *tricarinatus*, the two forms are very similar. When the types of *neomexicanus* can be compared with those of *tricarinatus* the two may prove to be identical.

30. Leptothorax wheeleri M. R. Smith

L. wheeleri M. R. Smith, Ann. Ent. Soc. Amer., Vol. 22, p. 547, fig. 1 (1929) ♀ ♀.
Type loc: A & M College, Mississippi. Types: Coll. M. R. Smith, Coll. A & M College, Miss., M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: central Mississippi and Alabama north to Ohio.

Subgenus MYCHOTHORAX Ruzsky

31. LEPTOTHORAX (MYCHOTHORAX) CANADENSIS Provancher

In the present work I have returned to the position advocated by Carlo Emery in 1895 and reëstablished *canadensis* as a separate species. I am fully aware that this view will meet with opposition because of the long association of *canadensis* and its variants with *acervorum* or *muscorum*. Yet I cannot see how any other course will give relief from the incongruities which have resulted from forcing the variants of *canadensis* into a scheme designed to care for European species.

It may be recalled that in the same year when Provancher described *canadensis* (1887), E. André, whose acquaintance with North American ants was slight, reduced Provancher's species to a variety of the European *acervorum*. That the two insects are similar may be admitted but that there was justification for André's action may be strongly denied. This was apparent to Emery who, in 1895, threw over André's arrangement and reëstablished *canadensis* as a valid species. Had Emery's stand been followed, much subsequent difficulty might have been avoided. Instead, Wheeler elected to follow André. As a result the North American variants belonging to *canadensis* were allocated either to *acervorum* or to *muscorum*, a practice for which there is no justification and one which has seriously damaged the taxonomy of the group.

In order to make this clear it is necessary to consider briefly the characters which separate the European *acervorum* from *muscorum*. The thorax of *acervorum* is proportionally longer and lower than that of *muscorum*. The anterior face of the node of the petiole meets the summit in a distinct angle in *acervorum*, while in *muscorum* the summit of the petiolar node is evenly rounded and lacks a distinct angle at the junction with the anterior face. The postpetiole of *acervorum* is proportionally larger than that of *muscorum*. As may be seen, none of the above characters are easily employed in a key, hence for practical purposes the two species are separated on the basis of tibial pilosity. The tibiae of *muscorum* have the hairs fully appressed, those of *acervorum* have the hairs erect or semierect but never fully appressed.

On the basis of this last distinction, all the North American variants which have been assigned to *acervorum* would have to be transferred to *muscorum*. In every one of them the tibial hairs are fully appressed, a fact of which Wheeler was aware when he assigned them to *acervorum*. It is clear, therefore, that Wheeler utilized thoracic or petiolar structure in making his allocations. But here the situation is not much

better. There is not a single North American form assigned to *acervorum* in which the proportions of the postpetiole are comparable to those of the European form. They all have a comparatively small postpetiole which is certainly more like that of *muscorum* than that of *acervorum*. Why, then, may not these forms be regarded as representatives of *muscorum?* The difficulty lies in the fact that in every case the structure of the thorax and that of the petiolar node allies these forms to *acervorum* rather than to *muscorum*.

It requires no particular acumen to appreciate that the present arrangement of the North American variants in the *acervorum-muscorum* complex is completely indefensible. There is no logical basis by which it can be justified and it is highly damaging not only to our own species but to *acervorum* and *muscorum* as well. With the North American variants of *canadensis* treated as representatives of *acervorum* and *muscorum*, the sharp distinction which marks the two European species is destroyed. There is no doubt whatever that *acervorum* and *muscorum* are separate species, for they not only show significant and constant structural differences but they maintain these over ranges which are extensive and largely coincidental. There can be no excuse for damaging this clear-cut situation by attempting to expand the specific limits of *acervorum* and *muscorum* to include North American representatives which cannot properly be assigned to either species. By recognizing *canadensis* as a separate species, we will not only improve the taxonomic position of *canadensis* but also that of *acervorum* and *muscorum* as well. I believe that the complex of variants belonging to *canadensis* should be treated as follows:

L. (*Mychothorax*) *canadensis* Provancher
= var. *convivialis* Wheeler
subsp. *calderoni* Forel
= var. *septentrionalis* Wheeler
subsp. *kincaidi* Pergande
subsp. *yankee* Emery
= var. *sordidus* Wheeler
= var. *obscurus* Viereck

The insect described by Wheeler as *acervorum* subsp. *crassipilis* must be regarded as a separate species. The arrangement proposed above is supported by zoögeographical data. Only two of the forms, the typical *canadensis* and the subspecies *yankee*, occur in the same geographical area and these two have ranges which are separated by different elevations. The ranges of all four subspecies merge in southern British Columbia and southwestern Alberta. In this region

numerous intergrades are produced. There follows the synonymy of *Leptothorax* (*Mychothorax*) *canadensis* Provancher:

L. canadensis Provancher, Addit. Faune Canad. Hym., p. 245 (1887) ♀ ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 8, p. 318 (1895) ♀.
L. acervorum var. *canadensis* E. André, Rev. Ent. Caen, Vol. 6, p. 259 (1887) ♀.
L. acervorum subsp. *canadensis* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 225, pl. 12, fig. 4 (1903) ♀ ♀.
L. (*M.*) *acervorum* subsp. *canadensis* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 574, pl. 12, fig. 45 (1947) ♀.
L. acervorum var. *convivialis* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 228 (1903) ♀.
Type loc: Cap Rouge, Ottawa, Ontario. Types: Lavalle Univ. Coll. Quebec?
Range: coast to coast in Canada and the northern United States with a southern extension in the Rocky Mountain Region to Colorado.

It is probable that *canadensis* occurs on many of the higher peaks in the southern Appalachians but its distribution south of Pennsylvania must be very discontinuous. Even in southern New York *canadensis* is rather strictly limited to mountainous areas. In the west the elevation at which *canadensis* occurs is notably affected by the latitude. In central Colorado the insect usually nests at elevations of 8000 feet or more. In northern Montana the range descends to 4000 feet or less. In Canada the conditions apparently permit an uninterrupted swing to the east, although records from Saskatchewan, Manitoba and western Ontario are scarce.

I have synonymized the variety *convivialis* with *canadensis* because it is impossible to attach any geographical significance to the slight differences of size and color on which this variety was established. Such variations occur throughout the entire range of the typical *canadensis*.

32. Leptothorax (Mychothorax) canadensis calderoni Forel

L. (*M.*) *acervorum* subsp. *canadensis* var. *calderoni* Forel, Deutsche Ent. Zeitschr., p. 617 (1914) ♀ ♀.
L. (*M.*) *muscorum* var. *septentrionalis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 511 (1917) ♀ ♀ ♂.
Type loc: Lake Tahoe, California. Types: none in this country.
Range: northern California into British Columbia and Alberta.

The form described by Wheeler as *muscorum* var. *septentrionalis* is, in my opinion, an intergrade between *calderoni* and *kincaidi*.

33. Leptothorax (Mychothorax) canadensis kincaidi Pergande

L. yankee var. *kincaidi* Pergande, Proc. Wash. Acad. Sci., Vol. 2, p. 520 (1900) ♀ ♀.

L. acervorum subsp. *canadensis* var. *kincaidi* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 227, pl. 12, fig. 5 (1903) ♀.

Type loc: Metlakahtla, Alaska. Types: U.S.N.M., A.M.N.H., M.C.Z.

Range: Alaska south through British Columbia and western Alberta to the mountains of Washington.

34. Leptothorax (Mychothorax) canadensis yankee Emery

L. canadensis var. *yankee* Emery, Zool. Jahrb. Syst., Vol. 8, p. 319 (1895) ♀.

L. acervorum subsp. *canadensis* var. *yankee* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 227, pl. 12, fig. 5 (1903) ♀.

L. muscorum var. Emery, Zool. Jahrb. Syst., Vol. 8, p. 318 (1895) ♀.

L. muscorum var. *sordidus* Wheeler, Proc. Acad. Nat. Sci. Phila., p. 224, pl. 12, fig. 2 (1903) ♀.

L. acervorum subsp. *obscurus* Viereck, Trans. Amer. Ent. Soc., Vol. 29, p. 72 (1903) ♀.

Type loc: Hill City, South Dakota (by present restriction). Types: A.M.N.H., M.C.Z.

Range: the Rocky Mountain region from New Mexico to British Columbia and east to the Black Hills of South Dakota.

Although the range of *yankee* corresponds closely with the western portion of the range of the typical *canadensis*, the two insects are separated by an elevational difference which keeps them apart, except in southern British Columbia. As has already been noted, the typical *canadensis* occurs at elevations of 8000 feet or more in central Colorado. In this latitude the subspecies *yankee* usually occurs at elevations between 5500 and 7000 feet. The elevational drop which occurs as the range of the typical *canadensis* runs northward is much less marked in the case of the subspecies *yankee*. Hence, the ranges of the two subspecies approach and meet in southern British Columbia.

There would seem to be no doubt that Wheeler's variety *sordidus* is a synonym of *yankee*. When Wheeler described *sordidus* he had no types of *yankee* for comparison. Type material of *yankee* is now available for examination. I have been able to find no significant difference between the types of *yankee* and those of *sordidus*. It also seems clear that *obscurus* is a synonym of *yankee* and not, as Wheeler supposed, the same as *convivialis*. In this connection it seems worth noting that Wheeler was in error when he stated (1917) that the publication of his 1903 monograph of Leptothorax antedated Viereck's description of *obscurus*. Actually, the paper carrying the description

of *obscurus* appeared three months before Wheeler's monograph. This particular question of priority is actually a matter of no significance, since both forms involved are synonyms of much older variants.

35. Leptothorax (Mychothorax) crassipilis Wheeler

L. (*M.*) *acervorum* subsp. *crassipilis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 513 (1917) ☿ ♀ ♂.

Type loc: Manitou, Colorado. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.

Range: an extensive although discontinuous range in Colorado, Wyoming, Utah, Nevada and Arizona. The insect usually nests in foothills at elevations not exceeding 7000 feet.

The worker of *crassipilis* is very similar to that of *canadensis*, from which it differs mainly in sculpture and pilosity (see key). Nevertheless, I believe that *crassipilis* is a distinct species. The epinotum and the petiolar node of the male of *crassipilis* are smooth and shining. In the male of *canadensis* and its variants these parts are sculptured and opaque.

36. Leptothorax (Mychothorax) diversipilosus M. R. Smith

L. (*M.*) *diversipilosus* M. R. Smith, Proc. Ent. Soc. Wash., Vol. 41, No. 5, p. 179 (1939) ☿.

Type loc: Ft. Lewis, Washington. Types: U.S.N.M.

Range: known only from type material.

37. Leptothorax (Mychothorax) duloticus L. G. Wesson

L. (*M.*) *duloticus* Wesson, Ent. News, Vol. 48, p. 125, fig. 1, a, b (1937) ☿ ♀; Wesson, Bull. Brooklyn Ent. Soc., Vol. 35, p. 83, fig. 1, a, b (1940) ♂.

Type loc: Jackson, Ohio. Types: Coll. L. G. Wesson, Coll. W. S. Creighton.

Range: known only from Illinois and Ohio.

Slaves: *L. longispinosus*, *L. curvispinosus*.

38. Leptothorax (Mychothorax) hirticornis Emery

L. hirticornis Emery, Zool. Jahrb. Syst., Vol. 8, p. 319 (1895) ☿; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 224 (1903) ☿; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 41, No. 5, p. 177 (1939) ☿.

L. (*M.*) *hirticornis* subsp. *formidolosus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 415 (1915) ☿ ♀.

Type loc: Hill City, South Dakota. Types: none in this country.
Range: western Dakotas to eastern Colorado.

In a recent study of *hirticornis* Dr. M. R. Smith has cleared up several points which were difficult to explain. The type locality of *hirticornis* is Hill City, South Dakota and not Washington, D.C. as Emery supposed. This is entirely in consonance with field data on this species for all the records, except that for Emery's type specimen, come from areas in the Dakotas and Colorado. Dr. Smith has further shown that Wheeler's subspecies *formidolosus* is a synonym of *hirticornis*.

39. Leptothorax (Mychothorax) provancheri Emery

L. tuberum Provancher, Natural. Canad., Vol. 5, p. 359 (1880) ♀ ; Provancher, Faune Entomol. Canad. Hym., p. 602 (1883) ♀ (*nec* Fabricius).
L. provancheri Emery, Zool. Jahrb. Syst., Vol. 8, p. 320 (1895) ♀ ; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 229 (1903) ♀.
L. emersoni Wheeler, Amer. Naturalist, Vol. 35, p. 433 (1901) ♀ ♀ ♂; Wheeler, Proc. Acad. Nat. Sci. Phila., p. 230, pl. 12, fig. 6 (1903) ♀ ♀ ♂.
L. (*M.*) *emersoni* subsp. *hirtipilis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 515 (1917) ♀.
Type loc: Canada. Types: none in this country.
Range: eastern Canada and New England west to Alberta.

The original description of *provancheri* was made by Provancher. He made the mistake of confusing this insect with the European *tuberum* and presented what he thought was a redescription of *tuberum* in a paper published in 1880. Provancher later sent a specimen of his '*tuberum*' to André, who gave it to Emery. Emery recognized Provancher's homonym as a new species and described it under the name *provancheri* in 1895. Neither of these descriptions of *provancheri* is exhaustive but both stress one significant feature which clearly indicates the nature of *provancheri*. The postpetiole is described as smooth and shining, with short, longitudinal striae extending from its base onto the first gastric segment. These characteristics are very unusual in a member of the subgenus Mychothorax. They are, in point of fact, shown only by *provancheri* and Wheeler's *emersoni*. It seems clear that when Wheeler described *emersoni*, he had an imperfect knowledge of *provancheri*. The description which Wheeler gave for *provancheri* three years later is obviously a reshuffling of Emery's earlier description. Wheeler was never able to assign specimens to *provancheri* because he placed all such specimens with *emersoni*. In my opinion there is no doubt that Wheeler's *emersoni* is a synonym of *provancheri*. In

eastern Canada and New England the population of this species seems to be very uniform. In the west, where the range extends southward through the Rocky Mountains, it has produced the southern subspecies *glacialis*. Wheeler's *hirtipilis* is a form whose exact relationships can never be ascertained, since it was described from a single worker. It may be said, however, that this single type specimen does not show the distinctive differences of sculpture which Wheeler cited as its definitive characteristics. Instead, it has a sculpture that is almost identical with that of the typical *provancheri*. I can see no justification for according subspecific status to *hirtipilis*, particularly in view of the fact that it was based on a single specimen. This specimen is, nonetheless, of considerable importance, since it was taken in western Alberta. This seems to be the westernmost record for the typical *provancheri* to date.

The relationship of *provancheri* to its 'host', *Myrmica brevinodis*, has been presented in the discussion at the beginning of the genus Leptothorax.

40. Leptothorax (Mychothorax) provancheri glacialis Wheeler

L. emersoni subsp. *glacialis* Wheeler, Bull. Wisconsin Nat. His. Soc., Vol. 5, p. 71 (1907) ♀ ♀ ♂.

Type loc: Florissant, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: known only from type material.

Genus Symmyrmica Wheeler

(Plate 34, figures 1–2)

In 1902 C. V. Chamberlin discovered, near Salt Lake City, three mixed nests consisting of *Manica mutica* and a small guest ant to which Wheeler subsequently gave the name *Symmyrmica chamberlini*. Despite much subsequent examination of *mutica* colonies, no additional specimens of *chamberlini* have been taken. As a result, our knowledge of the habits of this insect is slight. Chamberlin observed that the inquiline constructed its own nest chambers so that they communicated with those of its host. The arrangement seems to be very similar to that found in the nests of *Leptothorax provancheri*, which is an inquiline of *Myrmica brevinodis*. It is possible that the relationships of *chamberlini* to *mutica* are similar to those of *provancheri* and

brevinodis but nothing certain can be stated until further observations can be made on this rare and interesting ant.

The general structure of the worker of Symmyrmica is closely similar to that of certain species of Leptothorax but Symmyrmica may be easily separated because of its peculiar, ergatoid male.

1. Symmyrmica chamberlini Wheeler

S. chamberlini Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 5, pl. 1, figs. 1–7 (1904) ♀ ♀ ♂; Wheeler, Ants, Columbia Univ. Press, p. 433, fig. 260 a–g (1910) ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 578 (1947) ♀ ♂.

Type loc: Salt Lake City, Utah. Types: A.M.N.H., M.C.Z.

Range: known only from type material.

Host: *Manica mutica*.

Genus Harpagoxenus Forel

(Plate 35, figures 1–4)

The genus Harpagoxenus is represented by only three species, the European *sublaevis* and the New World *americanus* and *canadensis*. All three of these insects enslave members of the genus Leptothorax. At present we know very little about the habits of *H. canadensis*. This is to be regretted, since there are indications that the habits of this insect may be of considerable phyletic interest. Like *sublaevis* it enslaves species belonging to the subgenus Mychothorax and like *sublaevis* it produces ergatoid females in considerable numbers. But unlike *sublaevis* it usually has normal females in the colonies as well. It would seem, therefore, that the position of *canadensis* is between that of *sublaevis*, where the ergatoid female has largely replaced the normal type, and that of *americanus*, in which the ergatoid female is rarely produced. The habits of *sublaevis* and *americanus* have been extensively recorded. The present account will deal mainly with those of the latter species. The first observations on the habits of *americanus* were made by Wheeler in 1910. There followed other studies by Sturtevant (1925, 1927) and the writer (1927, 1929). The most recent contribution is a very comprehensive survey of the biology of *americanus* published by Wesson in 1939. As a result of these observations, we now possess an unusually complete account of the activities of this insect. The essential features in the development of a colony of *americanus* are as follows:

Immediately after the nuptial flight, which occurs in July, the fecundated *americanus* female seeks out a nest of *L. curvispinosus* or *longispinosus*. She attempts to enter this nest by force and, if successful, kills or drives away the Leptothorax workers and queen. From the brood, which she appropriates, presently emerge more Leptothorax workers who accept the *americanus* queen, feed her and tend the eggs which she lays. The *americanus* workers do not emerge until the following spring. In the mature colony the slave-raids do not begin until after the nuptial flight has taken place. The raids are preceded by scouting forays in which individual *americanus* workers look for Leptothorax nests. When a nest is found the scout attempts to enter it and may succeed if the nest is a small one. If entry cannot be effected, the scout goes back to the home colony and returns with reinforcements. As a rule, the raiding band is a small one, rarely consisting of more than half a dozen workers, and is apt to break up en route to the scene of action. On reaching the Leptothorax nest the raiding party shows very little concerted action but their increased number usually permits them to force an entrance. The initial resistance of the Leptothorax is succeeded by panic. The Leptothorax then abandon their nest or make furtive attempts to carry out the brood until they are driven off or killed by the raiders. Having driven off the Leptothorax, the *americanus* workers appropriate their brood. The removal of this brood to the home nest is a lengthy process which may require several days. The brood is selectively treated, with a preference shown for worker pupae and large larvae. Small larvae, eggs and the pupae of sexual stages are usually rejected. Toward the end of the summer it frequently happens that one or more of the raiders remains permanently in the raided nest. This results in the formation of what Wesson has called a "secondary colony". What happens in this case is remarkable. The *americanus* worker becomes sexually functional and proceeds to lay eggs which may develop into workers, females and males. Wesson was able to show that the proportion of males produced under such circumstances is abnormally high and in many cases only males are produced. In several instances, however, these supposedly unfertilized, egg-laying workers produced female or worker eggs. This is a very remarkable situation and one which deserves additional study.

There are two widely different interpretations concerning the significance of the habits of Harpagoxenus. Wheeler and the writer have considered the ants of this genus as degenerate slave-makers which are on the way to becoming workerless parasites. Wesson (1939) takes exception to this view. He regards Harpagoxenus as "occupying a

position with respect to the Leptothorax which it enslaves quite analogous to that of Polyergus with respect to the Formicae enslaved by it." Wesson regards the position taken by Wheeler and myself as erroneous because our observations "happened to be limited for the most part to those that would give the impression of decadence in *H. americanus*". Wesson further objects strongly to the comparisons which Wheeler and I have drawn between the habits of Harpagoxenus and those of Polyergus. In this last particular I am inclined to agree that it is a mistake to contrast the behavior of two such dissimilar insects. In the broader view I remain unconvinced that Wesson has proven his contention. On the contrary, it appears that much of the excellent data which he has presented negates his position. Wesson draws a very convincing picture of the ferocity with which the *americanus* worker attacks the members of the Leptothorax nest. My 1927 paper, as well as that published in 1929, contained similar accounts. A highly organized slave raid should, however, consist of something more than the pugnacity of the individual. Wesson's observations show little evidence of well integrated raids on the part of *americanus*. He has called attention to the fact that raiders often penetrate small nests single-handed. His raiding parties were always small, frequently straggling, and the members of these parties acted without concerted effort in penetrating the raided nest. In my opinion the picture presented by Wesson is still one in which the raiders act primarily on individual initiative. It may be that 'degenerate' is the wrong term to apply to the slave raids of *americanus* but they assuredly cannot be regarded as paragons of efficiency in this respect. In addition, Wesson has presented data which seem remarkably pertinent in showing that the worker caste of *americanus* is undergoing reduction. In the thirty-two natural colonies which he had under observation the average number of *americanus* workers was nine. In one exceptionally large colony the number ran to fifty but in no other colony were there more than twenty-five *americanus* workers present. I have observed this same phenomenon so often in the field that I have no doubt whatever that the average number of *americanus* workers in a colony is exceptionally low. This is precisely what one would expect to find in the case of a group tending toward the elimination of the worker caste but it scarcely fits the case if we are to regard Harpagoxenus as a dominant and aggressive slave maker. Finally, Wesson has observed the highly significant fact that *americanus* will mate in the nest. This condition is rarely encountered in ants but it is the rule in the nests of certain workerless parasites.

Key to the species of Harpagoxenus

1. Median impression of the anterior margin of the clypeus broad and very shallow; front of the head finely punctate; rugae often replaced by punctato-granulose sculpture on the thoracic dorsum; node of the petiole, in profile, higher than its base is broad, the posterior peduncle short but distinct ..... *americanus*
   Median impression on the anterior margin of the clypeus narrow and rather deep; front of the head with delicate longitudinal rugae; thorax irregularly rugulose throughout; node of the petiole, in profile, as broad at the base as it is high, the posterior peduncle very indistinct ..... *canadensis*

1. Harpagoxenus americanus (Emery)

Tomognathus americanus Emery, Zool. Jahrb. Syst., Vol. 8, p. 272 (1895) ♀.
H. americanus Wheeler, Ants, Columbia Univ. Press, p. 494 (1910) ♀; Creighton, Psyche, Vol. 34, No. 1, p. 28, figs. 1a, 2a, b (1927) ♀ ♂; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 41, No. 5, p. 166, fig. 1 c (1939) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 574, pl. 12, fig. 46 (1947) ♀.

Type loc: Washington, D.C. (worker); Tuxedo, New York (male); Jackson, Ohio (female). Types: worker and female, U.S.N.M.; male, Coll. W. S. Creighton.

Range: Massachusetts and southeastern Ontario south to Virginia and west to Ohio.

Slaves: *Leptothorax longispinosus* and *curvispinosus*.

2. Harpagoxenus canadensis M. R. Smith

H. canadensis M. R. Smith, Proc. Ent. Soc. Wash., Vol. 41, No. 5, p. 169, figs. 1 a, b, 2a, b, c (1939) ♀; Gregg, Canad. Ent., Vol. 77, p. 74, fig. 1a, b (1945) ♀.

Type loc: Quebec, Canada (female); Duluth, Minnesota (worker). Types: female: U.S.N.M., M.C.Z., A.M.N.H., Can. Nat. Mus. Ottawa, Coll. W. S. Creighton; worker: U.S.N.M., Coll. R. E. Gregg.

Range: Nova Scotia and Quebec west to Minnesota.

Slave: *L.* (*Mychothorax*) *canadensis*.

Through the generosity of Mr. Walley of the Ottawa Museum I was given a cotype from the type series of this interesting species. A study of this specimen has convinced me that it may be very difficult to draw a hard and fast line between the 'simple ergatoid female' of *canadensis* and the worker. The median ocellus of the ergatoid is small and obscure and the thorax is extraordinarily like that of the worker. It would not be surprising if further investigation of this

species shows that all the workers can act as functional females. It is seldom that one encounters a genus which possesses so many entertaining possibilities for investigation as Harpagoxenus.

Genus TRIGLYPHOTHRIX Forel

This genus, which is endemic to Africa and southern Asia, is represented in the New World by a single "tramp" species *striatidens*. As nearly as can be determined, the original home of *striatidens* was southern India. Within the last half century this insect has been reported from tropical regions in all parts of the world. There have also been a number of records coming from stations well to the north of the tropics. Nearly all such records refer to colonies which have entered green-houses with introduced plants, but they are of interest because they indicate the ease with which this insect is dispersed by commerce. I have treated *T. striatidens* as a member of the North American ant fauna because there is now good evidence that this insect has been able to adapt itself to the conditions in the southeastern United States and is firmly established in that area. The first notice of the appearance of *striatidens* in America north of Mexico was the publication of a paper by Wheeler in 1916. The record was based upon specimens which had been taken by E. R. Barber at Audubon Park, Louisiana, in 1913. Since that time *striatidens* has been reported from Mississippi, Alabama, Florida and South Carolina. To judge from the few observations which I have been able to make on this insect in southern Alabama, *striatidens* does not tend to dominate the area where it occurs. The tendency to overpopulation with the resulting depletion or exclusion of the native ant fauna is so often found in the case of introduced species of ants that the absence of this feature in the case of *striatidens* is worthy of note. In its native habitat *striatidens* is said to be a common and widely distributed insect. Its sporadic occurrence in the southeastern United States, where it is not at all abundant, may indicate that *striatidens* is barely able to hold its own against climatic conditions which are more rigorous than those of its original habitat.

There is little likelihood that *striatidens* could be confused with any of our native ants. The trifid hairs, which are the generic characteristic of Triglyphothrix, are very distinct. In general appearance *striatidens* suggests a small, very hairy replica of Xiphomyrmex. It may be noted that the degree of elevation and the amount of curvature of the epinotal spines both vary in *striatidens*. Most of the American specimens which I have seen have perfectly straight epinotal spines

which are much less elevated than those shown in Wheeler's 1916 figure. They agree much more closely in this respect with the figure which Dr. Smith published in 1947.

1. Triglyphothrix striatidens (Emery)

(Introduced)

Tetramorium obesum subsp. *striatidens* Emery, Ann. Mus. Stor. Nat. Genova, Vol. 27, p. 501 (1889) ♀.

T. striatidens Forel, Bombay Nat. Hist. Soc., Vol. 14, p. 704 (1902) ♀; Bingham, Fauna Brit. India Hym., Vol. 2, p. 173 (1903) ♀; Wheeler, Journ. Econ. Ent., Vol. 9, No. 6, p. 568, fig. 39 (1916) ♀ ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 579, pl. 13, fig. 47 (1947) ♀.

Type loc: Bhamo, Burma. Types: none in this country.

Range: (In the United States) southeastern United States north to the Carolinas.

Genus Tetramorium Mayr

(Plate 36, figures 1–5)

The five species belonging to this genus which have been taken in the United States present a number of interesting problems. All have been regarded as introduced ants. From a statistical standpoint the evidence for this view is strong. Tetramorium is unquestionably an Old World genus with the majority of the species showing paleotropical affinities. Moreover, three of the forms which occur in the New World, *guineense*, *simillimum* and *pacificum*, are tramp species which have been widely spread by commerce. A fourth, *caespitum*, occurs more widely in Europe and Asia than in North America. This leaves only *lucayanum* of the Bahamas and *rugiventris* of Arizona for which no Old World counterparts are known. Although the last species shows no evidence of introduction, Dr. M. R. Smith has been at considerable pains to provide an explanation covering the possibility that it might be an introduced species. It would seem that we are never to get away from the view that there are no species of Tetramorium endemic to the New World. In 1934 I presented evidence to show that *caespitum* should be regarded as a native North American species. I have seen nothing in the meantime which has altered my opinion. There is no sound reason why every species of Tetramorium which occurs in the New World must be regarded as an immigrant. I shall return to this matter in a subsequent paragraph but first it is necessary to consider the status of those species which are known to have been introduced.

T. guineense, simillimum and *pacificum* fall into this category. The first two species are now so widely distributed that there is doubt as to exactly where they originated. It is generally believed that both are African. *T. pacificum* is a species endemic to Malaysia and the islands of the southwestern Pacific. The problem with these species is not their introduction but rather the question as to how they have reacted to introduction. Of the three, only *guineense* shows evidence of naturalization. This species now behaves as a native ant in many parts of the south. While it frequently enters buildings, it seems capable of surviving winter conditions without protection, at least in the region bordering the Gulf of Mexico. Neither *simillimum* nor *pacificum* show a comparable behavior. It is possible that the first species has established itself in Florida and the last in California but the evidence is inconclusive in each case. It seems more probable that both species can survive only if given winter protection, hence they are 'established' under the artificial conditions which they find in dwellings and greenhouses. That either species has become a member of our ant fauna in the full sense of the term seems very questionable.

We may now consider the case of *caespitum* and *rugiventris*, both of which are, in my opinion, native North American species. Since different factors apply to these two species it is best to treat them separately.

The range of *caespitum* in North America includes most of the eastern half of the United States. It has also been reported from California. In the eastern states the insect is nowhere very abundant except in certain areas along the Atlantic Coast. There is indisputable evidence that *caespitum* has been present in the region extending from the Atlantic Seaboard to the Mississippi Valley for more than half a century. In 1895 Emery reported *caespitum* from several Atlantic states as well as from Tennessee and Nebraska. We know, therefore, that fifty years ago the distribution of this insect in the United States was almost identical with what it is today. Since there is no recent evidence to indicate that *caespitum* is behaving as an introduced species, some remarkable assumptions have been advanced to cover this deficiency.

About 1745 Peter Kalm was sent to this country from the University of Abö to look for a mulberry tree that would resist cold. During his visit he observed many things, among them ants, and recorded the fact that in 1748 a small, brown ant was infesting houses in Philadelphia. In recent years Marlatt has associated this ant with *caespitum* and there is no reason why he could not be right. But it is one thing to show that *caespitum* may have been present in eastern America in colonial times and quite another to prove that the col-

onists brought it here. Both Wheeler and Smith have fallen into this trap. In 1927 Wheeler observed that, if Marlatt was right in his association, then *caespitum* 'must have been introduced into the United States during colonial days'. In 1943 Smith stated that 'there is every reason to believe that this species was brought in by the early colonists'. Both these statements are no more susceptible to proof than the claim that *caespitum* disembarked with the Pilgrims on Plymouth Rock. Both stem from the conviction that this species *must* be an introduced ant. The writer lacks that conviction.

I believe that I am correct in stating that the only published data which can be cited in support of the view that *caespitum* is an imported species are those presented by Wheeler in 1927. In that year he reported the appearance of *caespitum* in metropolitan Boston. Since he was able to show that in earlier years the incidence of *caespitum* in New England had been very low, its comparatively sudden increase called for some explanation. Wheeler supplied this by assuming that the insect had migrated into Massachusetts from Connecticut. Wheeler had found *caespitum* abundant in the latter state and southern New York as early as 1905. If Wheeler is correct in his belief that *caespitum* migrated into eastern Massachusetts during the period between 1905 and 1927, this action is certainly not what one would expect of a native species. On the other hand, it should be remembered that Wheeler made no claim that *caespitum* was absent from Massachusetts prior to the 'migration'. On the contrary, he mentioned specimens taken by Dimmock at Springfield (apparently about 1915). Hence the gain in incidence which Wheeler noted in 1927 is not certainly attributable to migration and may have been due to conditions which favored the increase of a population already present.

Since it seems so difficult to arrive at any positive data on the distributional characteristics of *caespitum* in the New World, let us see if more satisfactory conclusions may not be drawn from its behavior elsewhere. *T. caespitum* differs from most of its congeners in that it cannot properly be considered a paleotropical species. The enormous range of *caespitum* begins in England and extends across Europe and northern Asia to Japan. There is a southern extension which surrounds the Mediterranean Basin, where the species has developed a multitude of minor variants. Two or three variants enter tropical Africa and one has reached the Kalahari Desert. But by far the greater part of the range of *caespitum* lies in a region where holarctic species occur. Despite its southern fringes in Africa, *caespitum* has a holarctic coverage which few species can match. Yet this fact is usually subordinated to its much less uniform occurrence in Africa. If we consider the holarctic affinities of *caespitum*, there is nothing at

all unusual in the fact that it should occur in Europe, Asia and North America. Many holarctic species occur on all three continents and such a circumpolar distribution is considered entirely natural. Why should it be necessary to make an exception in the case of *caespitum?*

There can be little doubt as to why this has been done. Since *guineense* and *simillimum* are 'tramp species', *caespitum* has been marked with the same brand. This argument from analogy seems to have little basis in fact. It may be admitted that *caespitum* shows some slight tendency toward dissemination by commerce. The few records from southern Africa mentioned above are so far removed from the main range that it is difficult to account for them in any other way. But that this tendency reaches notable proportions may be strongly denied. There is no other conclusion to be drawn from the failure of *caespitum* to establish itself on the continents of South America and Australia. No comparable failures mark those ubiquitous tramps, *guineense* and *simillimum.* We have been attributing to *caespitum* distributional peculiarities which it does not possess. Hence its 'importation' to the United States is not the normal reaction of a 'tramp species' but an exceptional case. If *caespitum* has been imported to America, this represents the only instance in which the insect has been able to establish itself in a new continental area after importation.

I have undertaken the lengthy discussion just presented because it seems clear that the idea of *caespitum* as an introduced species will not be easily displaced. It seems possible that a full review of the facts might succeed where data which I presented in 1934 have failed. In that year I described what I believed to be a new species of the rare, parasitic genus Anergates, whose host species is *caespitum.* The insect was taken in New Jersey. I had then, and have now, no doubt as to what this discovery meant as far as the status of *caespitum* is concerned. The discovery of Anergates in America rules out the possibility that *caespitum* might have been imported to this country. I confess that I did not greatly stress this point, for it seemed too obvious to require comment. But while the presence of Anergates in this country has been accepted, the implication of this fact on the status of *caespitum* has been avoided. *Tetramorium caespitum* is still treated as an imported ant and the theory that there can be no endemic species of Tetramorium in the New World continues in full force. This has produced some rather surprising results, as may be seen from the following paragraph.

In 1943 Dr. M. R. Smith described *Tetramorium rugiventris.* The type series of this interesting species was taken near Prescott, Arizona. There was nothing whatever in the situation of the nest to indicate that the insect had been imported. There were, presumably, no

dwellings nearby. The nest was secured in an upland grove of ponderosa pines a mile from the main highway and ten miles south of Prescott. It would be hard to imagine a more unlikely station for an introduced species. Yet Dr. Smith felt it necessary to provide a way out for those who believe that there are no species of Tetramorium endemic to North America. He mentioned the possibility that *rugiventris* might have been introduced at the middle of the last century. At that time camels were brought to this country for use in desert transport in the southwestern states. If it is assumed that food and stores were brought from Africa with the camels, it may further be assumed that *rugiventris* might have come in with these stores. Dr. Smith's ingenious explanation is both entertaining and novel. Entomologists frequently strain at gnats but it is seldom that they are asked to swallow a camel. While I admire the tenacity with which Dr. Smith adheres to the 'tramp species' theory, I find myself unwilling to perform the mental gymnastics that such adherence now entails. Since everything points to *rugiventris* as a native species I propose to treat it as such until more convincing reasons are given as to why it should not be so considered.

It may also be noted that the writer has followed Emery in treating Santschi's *Tetramorium silvestrii* as a member of the genus Leptothorax. Although *silvestrii* was described from specimens taken in Arizona and has a gastric sculpture which strongly suggests that of *rugiventris,* it seems preferable to concur with Emery's generic reallocation until the exact nature of *silvestrii* is better known. There would seem to be no limit to the problems connected with this difficult genus and it is to be hoped that additional efforts will be made to clear up some of the controversial points connected with our forms. The following key is essentially that which Dr. M. R. Smith presented in his 1943 study of Tetramorium.

Key to the species of Tetramorium

1. Antennal sulcus absent 2
   Antennal sulcus present 3
2. Basal half of the first gastric segment longitudinally rugulose, subopaque; antennal scapes extending past the posterior border of the head; clypeus with a median impression; head and thorax rugulose reticulate. . *rugiventris*
   Basal half of the first gastric segment smooth and shining; antennal scapes not reaching the posterior border of the head; clypeus without a median impression; head and thorax longitudinally striated ..... *caespitum*
3. Hairs on head, thorax and petiolar nodes short, erect and enlarged apically; head longitudinally rugulose, the spaces between the rugules finely granulose ..... *simillimum*

Hairs and sculpture not as described above 4

4. Node of the petiole in profile subrectangular, the top of the node not sloping forward and forming a sharp angle with the abruptly descending anterior face; color reddish yellow, the gaster brownish or blackish ..... *guineense*
Node of the petiole in profile with the upper face gradually sloping forward and meeting the anterior face in a very broadly rounded angle; color light brown or yellowish brown ..... *pacificum*

The total number of bibliographic citations for *caespitum, guineense* and *simillimum* is now very large. The lists presented below have been severely edited, particularly in the case of the older descriptions. Many of these are of little more than historical significance at present and it seems unnecessary to carry them when there are so many adequate descriptions of these species extant. For a more comprehensive listing the reader may consult the myrmicine section of Emery's *Genera Insectorum* (Fasc. 174, 1922).

1. Tetramorium caespitum (Linné)

Formica caespitum Linne, Syst. Nat. Ed. 10, Vol. 1, p. 581 (1758) ♀.

T. caespitum Mayr, Verh. Zool-bot. Ver. Wien., Vol. 5, p. 246 (1855) ;Mayr, Europ. Formicid., p. 61 (1861); Forel, Fourmis Suisse, p. 72 (1874); E. André, Spec. Hym. Europe, Vol. 2, p. 285 (1882); Emery, Deutsche Ent. Zeitschr., p. 679, fig. 2 (1909); Donisthorpe, Brit. Ants, p. 170, pl. 9 (1915); Forel, Fauna Ins. Helvet. Hym. Form., p. 14 (1915); Emery, Bull. Soc. Ent. Ital., Vol. 47, p. 194, fig. 54 (1916); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 580, pl. 13, fig. 48 (1947) ♀.

Myrmica brevinodis var. *transversinodis* Enzmann, Journ. N.Y. Ent. Soc., Vol. 54, No. 1, p. 48, figs. 1, 2 (1946) ♀.

All references are for all three castes unless otherwise noted.

Type loc: 'in Europae tuberis'. Types: none in this country.

Range: northeastern states south to Tennessee and west to Missouri and Nebraska. Also occurs in California.

2. Tetramorium guineense (Fabricius)

(Introduced)

Formica guineense Fabricius, Ent. Syst., Vol. 2, p. 357 (1793) ♀.

T. guineense Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 972 (1870) ♀. E. André, Spec. Hym. Europe, Vol. 2, p. 288 (1892) ♀ ♀ ♂; Forel, Grandidier Hist. Madagascar, Vol. 20, p. 154 (1891) ♀ ♀ ♂; Bingham, Fauna Brit. India, Hym., Vol. 2, p. 184 (1903) ♀; Emery, Deutsche Ent. Zeitschr., p. 695 (1909) ♀ ♀ ♂; Arnold, Ann. So. Afr. Mus., Vol. 14, p. 306 (1917) ♀; M. R. Smith, Proc. Ent. Soc. Wash., Vol. 45, No. 1, p. 3, fig. 1 (1943) ♀.

Type loc: Guinea. Types: none in this country.
Range: (in the United States) southern Florida to Texas. Scattered records from greenhouses in various parts of the country.

It seems well to note that the episternal teeth or spines in the worker of *guineense* vary considerably in length. The spines may be short and toothlike (as shown in the figure of *guineense* which Dr. Smith presented in 1943) or they may be almost as long as the epinotal spines. Most of the specimens of *guineense* which the writer has examined have had fairly long episternal spines but Dr. Smith, who has examined many thousands of specimens of *guineense*, writes me that in his opinion the spine length is not constant enough to be a reliable separatory character.

3. Tetramorium pacificum Mayr

(Introduced)

T. pacificum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 972 (1870) ♀ ♀.
Type loc: Tongatabu, Friendly Islands. Types: none in this country.
Range: (in the United States) California.

4. Tetramorium rugiventris M. R. Smith

T. rugiventris M. R. Smith, Proc. Ent. Soc. Wash., Vol. 45, No. 1, p. 4 (1943) ♀.
Type loc: Prescott, Arizona. Holotype: U.S.N.M., Paratypes: A.M.N.H., M.C.Z.
Range: known only from type material.

5. Tetramorium simillimum (F. Smith)

(Introduced)

Myrmica simillimum F. Smith, List. Brit. Anim. Brit. Mus. part 6, Acul., p. 118 (1851) ♀.
T. simillimum Mayr, Europ. Formicid., p. 61 (1861) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 972 (1870) ♀; E. André, Spec. Hym. Europe, Vol. 2, p. 287 (1882) ♀ ♀ ♂; Bingham, Fauna Brit. India, Hym., Vol. 2, p. 185 (1903) ♀; Emery, Deutsche Ent. Zeitschr., p. 695 (1909) ♀ ♀ ♂; Arnold, Ann. S. Afr. Museum, Vol. 14, p. 326 (1917) ♀ ♀ ♂.
Type loc: Dorsetshire, England. Types: none in this country.
Range: (in the United States) southern Florida, with scattered records from greenhouses in various parts of the country.

Genus XIPHOMYRMEX Forel

(Plate 37, figures 1–4)

The genus Xiphomyrmex is represented in the New World by a single species, *spinosus*, which has produced several subspecies in the southwestern United States and northern Mexico. *X. spinosus* and its subspecies are strictly limited to Sonoran areas. All the nests which I have taken have been situated on upland plains or in the foothills of mountains at elevations between five and six thousand feet. The colonies are small, seldom containing more than a hundred individuals and the insects are not particularly active. According to Wheeler, the workers forage singly but this is certainly not always the case. The nest is frequently surmounted by a small crater, especially when it is constructed in light soil, but in coarse soil the crater is often absent. The insect appears to be carnivorous and is not believed to store seeds.

The following key for the separation of the subspecies of *spinosus* is taken from the review of that species which was published by Dr. M. R. Smith in 1938. It does not include the typical *spinosus*, which does not occur north of the Mexican border.

Key to the subspecies of Xiphomyrmex spinosus Pergande

1. First gastric segment finely punctulate or shagreened, subopaque toward the base ..... *spinosus* subsp. *hispidus*
   First gastric segment entirely smooth except for scattered piligerous punctures 2
2. Metasternal angles acute, spiniform; thorax viewed from above with an indistinct mesoepinotal constriction ..... *spinosus* subsp. *insons*
   Metasternal angles blunt, not spine-like; thorax viewed from above with a distinct mesoepinotal constriction ..... *spinosus* subsp. *wheeleri*

1. XIPHOMYRMEX SPINOSUS HISPIDUS Wheeler

X. spinosus subsp. *hispidus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 415 (1915) ♀; M. R. Smith, Jour. Wash. Acad. Sci., Vol. 28, No. 3, p. 129 (1938) ♀.

Type loc: Tucson, Arizona. Types: M.C.Z., Coll. W. S. Creighton.

Range: deserts of southern Arizona.

2. XIPHOMYRMEX SPINOSUS INSONS Wheeler

X. spinosus subsp. *insons* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 416 (1915) ♀ ♀; M. R. Smith, Jour. Wash. Acad. Sci., Vol. 28, No. 3,

p. 129 (1938) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No .3, p. 580, pl. 13, fig. 49 (1947) ♀.
Type loc: Austin, Texas. Types: M.C.Z.
Range: western Texas. Most of the range of *insons* lies in the Trans-Pecos area. The type locality seems to be close to the eastern limit of the range.

3. Xiphomyrmex spinosus wheeleri Forel

Tetramorium (*X.*) *wheeleri* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 128 (1901) ♀.
X. spinosus subsp. *wheeleri* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 416 (1915) ♀; M. R. Smith, Jour. Wash. Acad. Sci., Vol. 28, No. 3, p. 130 (1938) ♀.
Type loc: Pacheco, Zacatecas, Mexico. Types: A.M.N.H.
Range: southern Arizona into Mexico.

There has been some question concerning the status of material coming from the Huachuca Mountains which has been referred to *wheeleri* despite minor differences of structure. Both Wheeler (1915) and Smith (1938) noted the differences which distinguish these specimens but neither cared to give them a name. As I have a large series of specimens which were secured in the Huachucas in 1932, I believe that this difficulty may be resolved. A considerable proportion of the specimens appear to me to be indistinguishable from the Texas subspecies *insons*. A number of others, however, have a gastric sculpture which suggests a relationship to *hispidus* or *spinosus*. The area of shagreening is considerably reduced, but the base of the first gastric segment is distinctly sculptured. It would appear that these insects are intergrades between *insons* and *hispidus*. I entirely agree with Wheeler and Smith that it is inadvisable to name them.

Genus Wasmannia Forel

This genus is represented in our ant fauna by a single introduced species, *auropunctata*, which has recently become established in southern Florida. It is not surprising that this insect should have made its appearance there, since it has been carried all over the tropics in both the Old and New World. Moreover, *auropunctata* appears to be an exceedingly adaptable species as far as the type of nest site is concerned. M. R. Smith (1936) has pointed out that it will tolerate all sorts of nesting conditions from heavy shade to areas of extreme dryness and intense illumination. On the other hand, *auropunctata* shows no such adaptability in the matter of mean yearly temperature. It requires tropical or subtropical conditions and apparently cannot

tolerate the climatic conditions which occur along the Gulf coast. The severity of the sting of this little ant is out of all proportion to its small size. Coupled with its practice of tending various aphids this makes *auropunctata* a rather undesirable addition to our ant fauna. It may, in course of time, become a serious pest in southern Florida but it is unlikely that it will be able to gain a foothold elsewhere. The northern limit of the range at present is in the vicinity of Ft. Lauderdale.

The appearance of the worker of *auropunctata* is quite distinctive and it is not apt to be confused with any of our native species. The antennae consist of eleven joints, with the last two forming a distinct club. The terminal joint of the club is more than a third as long as the remainder of the funiculus and is thickened in the middle so that it is much wider than the penultimate joint. The antennal scrobes are well-marked and extend almost to the occipital border. The thorax has very pronounced humeral angles and a wavy, transverse welt across the pronotum just where the declivity to the neck begins. The epinotal spines are set close together at the base, strongly diverging and slightly incurved when seen from above. The node of the petiole is rectangular in profile and higher than the postpetiole. The erect body hairs are long, coarse and rather sparse.

1. Wasmannia auropunctata (Roger)

(Introduced)

Tetramorium auropunctatum Roger, Berl. Ent. Zeitschr., Vol. 7, p. 182 (1863) ♀ ♀ ♂; Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 20, p. 375 (1884) ♀.

W. auropunctata Forel, Trans. Ent. Soc. Lond., p. 383 (1893) ♀ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 143, pl. 12, fig. 18 (1908) ♀; M. R. Smith, Puerto Rico Univ. Jour. Agr., Vol. 20, p. 845 (1936) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 582, pl. 13, fig. 50 (1947) ♀.

Type loc: Cuba. Types: none in this country.

Range: (in the United States) southern Florida.

Genus Cryptocerus Fabricius

(Plate 38, figures 1–6)

In 1947 Dr. M. R. Smith published a highly detailed account of the three species of Cryptocerus which occur within our borders. Myrmecologists should find this paper useful, for it brings together much data on Cryptocerus which has formerly been widely scattered

through the literature. This interesting Neotropical genus enters the United States at three widely separated points. *C. varians* occurs in southern Florida, *C. texanus* inhabits southwestern Texas and *C. rohweri* is found in southern Arizona.

Remarkably little is known concerning the habits of the members of this genus. It seems likely that most of the species are arboreal or at least prefer to nest in plant cavities. An interesting observation in this connection has been published by Dr. Neal Weber (1934). He observed that workers of *C. varians*, which he had under observation in an artificial nest, could run backwards as fast as they could run forward. He interpreted this as a response to a life spent in hollow twigs where, it may be presumed, a good deal of backing-up would be necessary. This species has another curious reaction which the writer has often observed. The body of this insect is flattened in a dorsoventral plane with the dorsal surface in particular showing a remarkably level contour. If disturbed they take full advantage of the protection which this gives by flattening themselves as close to the substrate as possible. When they have assumed this crouching position it is almost impossible to pick them up unless tweezers are used. This reaction is quite unlike that of many arboreal ants which rely on their agility to escape molestation. Both Emery and Wheeler have assumed that the extraordinary saucer-like head of the major worker of Cryptocerus is used for blocking up the nest entrance. While there is no reason to doubt this assumption, there seems to be nothing but indirect evidence to support it at present. In 1905 Wheeler published a brief account of several nests of *C. varians* which he had found in hollow twigs. The opening into each nest was exactly the size and shape of the head of the major worker. The majors could, therefore, fulfill the function of a living door, as do those of Colobopsis. As to whether they actually do so will have to be determined by additional observations. Our three species may be separated as follows:

Key to the species of Cryptocerus

1. Upper surface of the head of the major forming an oval, concave, saucer-like structure which is closed in front except for a very narrow slit; epinotum of the smallest workers much depressed, the declivious face extremely short and largely hidden by the first petiolar node (Subgenus Cyathomyrmex) ..... *varians*
   Upper surface of the head of the major similar in structure but with the anterior rim open above the mandibles; epinotum of the smallest workers not notably depressed, the declivious face clearly visible above the first petiolar node (Subgenus Cryptocerus) 2

2. Head and thorax of the major worker with the pit-like impressions devoid of hairs except on the epinotum; gastric sculpture of the major including longitudinal rugulae at the base; thoracic sculpture of the minor in part longitudinally rugulose; gaster in all sizes of worker, entirely black *rohweri*

Head and thorax of the major worker with a silvery hair arising from most of the pit-like impressions; gaster of the major sculptured but without basal rugulae; thoracic sculpture of the minor not longitudinally rugulose; gaster in all sizes of worker, with two yellowish or whitish basal spots... *texanus*

Subgenus CRYPTOCERUS Fabricius

1. CRYPTOCERUS ROHWERI Wheeler

Cryptocerus (*Cyathocephalus*) *rohweri* Wheeler, Proc. N. E. Zool. Club., Vol. 6, p. 32, figs. 2 a, b (1916) ♀ ♁.

C. (*Cryptocerus*) *rohweri* Emery, Genera Insectorum, Fasc. 174, p. 310 (1922); M. R. Smith, Proc. Ent. Soc. Wash., Vol. 49, No. 1, p. 34 (1947) ♀ ♁ ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 584, pl. 14, fig. 51 (1947) ♁.

Type loc: Buehman Canyon, Santa Catalina Mts., Arizona. Types: M.C.Z.

Range: southern Arizona.

Wheeler originally assigned *rohweri* to the subgenus Cyathocephalus (now Cyathomyrmex), but there is no doubt that Emery was correct in reallocating the insect to the subgenus Cryptocerus. As Dr. Smith has pointed out, the type locality of *rohweri* is Buehman Canyon, not Buckman Canyon as Wheeler originally gave it. The type series was taken at an elevation of 3300 feet, and subsequent records indicate that the insect prefers to nest at low elevations in foothill canyons.

2. CRYPTOCERUS TEXANUS Santschi

Cryptocerus texanus Santschi, Bull. Soc. Ent. Fr., p. 208, fig. 2 (1915) ♀ ♁.

C. (*Cryptocerus*) *texanus* M. R. Smith, Proc. Ent. Soc. Wash, Vol. 49, No. 1, p. 37 (1947) ♀ ♁ ♀ ♂.

Type loc: Texas. Types: none in this country.

Range: southwestern Texas, from San Antonio and Columbus south to Brownsville and into northern Mexico.

This species has been plagued by several annoying errata resulting from carelessness on the part of Santschi and Wheeler. Since these have not had any serious effect on the status of *texanus*, I see no cause

for reviewing them here. Those who are interested in such taxonomic curiosities will find a careful and discriminating treatment of the matter in Dr. Smith's paper cited above. It seems well to state, however, that prior to 1915 Wheeler's references to *texanus* were given under the name *angustus*.

Subgenus CYATHOMYRMEX Creighton

3. CRYPTOCERUS (CYATHOMYRMEX) VARIANS F. Smith

Cryptocerus varians F. Smith, Trans. Ent. Soc. Lond., p. 606, pl. 11, fig. 6 (1876) ♀; Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 211, pl. 4, fig. 33 (1894) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 102, pl. 7, figs. 1–6 (1905) ♀ ♁ ♀ ♂; Wheeler, Ants, Columbia Univ. Press, p. 90 (1910) ♀ ♁ ♀ ♂.

C. (*Cyathocephalus*) *varians* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 90, p. 212, pl. 54 (1942) ♀ ♁.

C. (*Cyathomyrmex*) *varians* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 584, pl. 14, fig. 52 (1947) ♀.

Type loc: Antilles (no particular island designated). Types: British Museum, if still extant.

Range: (in the United States) southern Florida.

This species is well named as far as color is concerned. The majority of the workers in a colony usually have a piceous brown coloration on the head and thorax with the gaster and the appendages a reddish brown. From this condition the color grades through castaneous brown to golden yellow. It has been generally assumed that these lighter colored individuals are callows but the writer is inclined to doubt this. Their integument is fully as hard as that of the dark colored workers and I have found them foraging outside the nest with the darker workers.

Genus STRUMIGENYS F. Smith

(Plate 39, figures 1–5)

The bizarre structure and highly specialized habits of the members of this genus make these insects especially interesting objects for study. It is regrettable that their small colonies are so difficult to find. We have very little information on the habits of many of our species. The outstanding contribution to the ecology of our North American forms of Strumigenys are the studies of L. G. and R. G. Wesson (1936,

1939). These investigators made observations in the field and on captive colonies in the case of several species. The habits of all the species studied were, in the main, remarkably constant. In each case the dietary staple of these ants was some species of Collembola. When one has observed the great deliberation with which Strumigenys moves, it seems remarkable that they should have adapted themselves to a diet consisting of insects so much more active than themselves. The collembolans are captured more by stealth and patience than by the foraging methods common to most ants, although certain species of Strumigenys will try to track down their prey. As a rule, however, the ant waits for the collembolan to blunder into its open mandibles, even when this has been preceded by a reconnaissance which has brought the two insects close together. The mandibles of Strumigenys can be opened to an unusual degree. In some species they can be brought back until their outer borders are almost in contact with the sides of the head. As to whether this is true of the species in the subgenus Trichoscapa is not clear from the Wessons' observations, but the writer has repeatedly observed it in the case of *S. louisianae* subsp. *laticephala* (1937). The widely opened mandibles have the same function as the jaws of a trap and are 'sprung' by contact with trigger hairs or maxillary lobes which project beyond the clypeal border. The closure of the mandibles is extraordinarily rapid and the insect which springs the trap is almost certain to be impaled on the sharp mandibular teeth, since the trigger hairs and lobes are shorter than the mandibles. The victim is stung and rapidly immobilized once it has been grasped by the mandibles. The writer has been able to make observations on *laticephala* which indicate that the mandibular mechanism may also be employed in defense. A number of small ants which were introduced into an artificial nest of *laticephala* were attacked and killed. In this case the Strumigenys did not wait for their victim to come to them but closed in on the intruder in a concerted attack. Although several Strumigenys would often be in close proximity during these attacks, they never struck each other with the mandibles. It is interesting to note that the dead ants were not used for food but were carried out and dumped on the refuse heap. There is no question that the dietary restriction of Strumigenys is high. The Wessons have been unable to get some of the species to eat anything but Collembola. The *laticephala* colony mentioned above fed on egg yolk or the dissected tissues of other insects, from which they sucked the juices.

The nests of Strumigenys are constructed in a variety of places. They are frequently found in rotten, punky wood but have also been taken in pine duff, in thick humus, under bark and in the soil beneath

stones and planks. Not infrequently these insects have been found in or near the nests of other genera of ants. Wesson believes that in such cases the Strumigenys are preying on the Collembola which often infest the nests of ants. He was able to show that in an artificial nest containing both *Strumigenys pergandei* and *Aphaenogaster fulva*, the larger insects made no attempt to molest the Strumigenys, although they were aware of their presence. As the Strumigenys maintained the individuality of their own nest chambers and resented the intrusion of the Aphaenogaster workers, the relationship between the two insects seems comparable to that existing between *Leptothorax provancheri* and *Myrmica brevinodis*. In the above case the only benefit which the larger ant would derive would be the gain resulting from the removal of the Collembola by the Strumigenys.

For many years the taxonomic status of the North American species of Strumigenys remained essentially in the form given it by Emery in 1895. At that time only seven representatives of the genus were known to occur in the United States. When Dr. M. R. Smith monographed this genus in 1931, he doubled the number of recognized forms. In subsequent years there has been a steady advance in the development of the group. In the present paper twenty-five species and subspecies are recognized. While the taxonomy of Strumigenys is not unusually difficult, the genus shows several features which can produce confusion. One of the most curious characteristics, at least as far as the majority of our species are concerned, is the extraordinary similarity of thoracic structure. As a general rule species of ants will show differences both in cephalic and thoracic structure. This is not the case with Strumigenys. The thoracic structure in most of our species is so similar that it is safe to say that, if one removed the heads of the insects, separation to species would be largely a matter of guess. This peculiarity is reflected in the several keys which have been presented. All of them are based mainly on cephalic characters. These characters have to do with the shape of the head, its sculpture and pilosity. It not infrequently happens that the peculiar, squamose hairs which occur in many of the species are so closely set that they obscure the outline of the parts which they cover. This is particularly true of those hairs which border the clypeus. Since the shape of the clypeus is an important diagnostic character in many cases it is often necessary to wet the head of the specimen with some liquid which will cut down the diffusion of light caused by the hairs before one can be certain of the shape of the clypeus. The same technique will give good results in the case of the mandibular teeth which are usually obscured by covering hairs. The constancy of tooth pattern appears to be very high and the type of dentition is a good character for separa-

tion. The shape of the head, although it has been more widely used in existing keys, is apparently less constant. Kennedy and Schramm (1933) have shown that in the case of *dietrichi* there may be considerable variations in head shape within a nest series. The above consideration has led me to minimize head shape wherever possible in the following key.

Key to the species of Strumigenys

1. Mandibles long and slender, the apex of each mandible armed with two large teeth set one behind the other, the remainder of the inner border of the mandible unarmed except for a single, small, subapical tooth (Subgenus Strumigenys) 2
   Mandibles much shorter, with the inner border armed with several teeth along its distal half and with a single, large triangular tooth at the base (Subgenus Trichoscapa) 3
2. Average size 2.5 mm.; head broad posteriorly, with the occipital incision more than half as wide as the greatest width of the head ..... *louisianae* subsp. *laticephala*
   Average size 2.25 mm.; head narrow posteriorly, with the occipital incision narrow and abrupt and not more than one-third as wide as the greatest width of the head ..... *louisianae*
3. Dorsal surface of the first gastric segment shagreened, subopaque; infraspinal lamella absent ..... *margaritae*
   Dorsal surface of the first gastric segment smooth and shining; infraspinal lamella present 4
4. Prothorax flattened and laterally margined; head largely destitute of hairs ..... *membranifera* subsp. *simillima*
   Prothorax not flattened or, if flattened, not margined; head with numerous hairs 5
5. Basal mandibular tooth fully exposed when the mandibles are closed; scapes strongly bent at the base 6
   Basal mandibular tooth partially or completely covered by the clypeus when the mandibles are closed; scapes not strongly bent at the base ... 7
6. Anterior edge of the clypeus straight and forming sharp angles with the sides; scapes bent at right angles ..... *angulata*
   Anterior edge of the clypeus convex and gradually passing to the sides; scapes bent at less than a right angle ..... *pergandei*
7. Clypeus in large part smooth and shining, without sculpture, or with the sculpture not heavy enough to dull the shining surface 8
   Clypeus heavily sculptured over most or all of its surface, opaque or subopaque in appearance 12
8. Hairs on the clypeus long and few; marginal groove of the clypeus very distinct ..... *bimarginata*
   Hairs on the clypeus abundant or, if few, the marginal groove is absent. 9
9. Clypeus subquadrate, broader than long, the anterior border only mod-

erately convex; hairs broadly squamose and so closely appressed that they partially obscure the shining surface of the clypeus..... *rohweri*
Clypeus longer than broad, the sides distinctly converging towards the strongly convex anterior border; clypeal hairs not as above.....10

10. Clypeal hairs very abundant, fine, straight, not enlarged apically and with their tips pointed..... *pilinasis* subsp. *laevinasis*
Clypeal hairs sparse or moderately numerous, enlarged apically or with the tips blunt.....11

11. Clypeus with not more than a dozen long hairs which do not form a marginal fringe..... *ornata*
Clypeus with moderately numerous, short, curved hairs which form a distinct marginal fringe..... *brevisetosa*

12. Entire head and promesonotum covered with numerous, spoon-shaped, squamose hairs..... *creightoni*
Squamose hairs, when present, less extensively distributed than above.13

13. Clypeal hairs long, their length one-third to one half the width of the clypeus.....14
Clypeal hairs short, their length seldom as much as one-fourth the width of the clypeus.....16

14. Clypeal hairs fine and abundant, more than fifty present.....15
Clypeal hairs coarse and sparse, not more than fifteen present... *dietrichi*

15. Hairs on the margin of the clypeus strongly curved and slightly broadened and flattened toward the apex..... *medialis*
Hairs on the margin of the clypeus weakly curved or straight, not at all flattened or broadened toward the apex..... *pilinasis*

16. Thorax with four large and conspicuous hairs, one of which occurs at each humeral angle and one at each side of the thorax where the mesonotal declivity begins..... *rostrata*
Thoracic pilosity not as above.....17

17. Clypeal hairs slightly, or not at all, enlarged and flattened apically, never strongly spatulate or spoon-shaped.....18
Clypeal hairs distinctly enlarged and flattened apically; notably spatulate or spoon-shaped.....20

18. Erect hairs on the clypeal margin all of about the same length, all strongly curved forward and together forming a conspicuous, even fringe.... *talpa*
Erect hairs on the clypeal border uneven in length and not all curved forward, the fringe which they form ragged and inconspicuous.....19

19. The length of the erect hairs on the clypeus less than one-eighth of the width of the clypeus, the hairs bent but not S-shaped..... *ohioensis*
The length of the erect hairs on the clypeus distinctly more than one-eighth the width of the clypeus, the hairs mostly S-shaped..... *manni*

20. Length of the clypeus (from the middle of the anterior margin to the frontal area) as great as, or slightly greater than, its maximum width... *clypeata*
Clypeus slightly but distinctly broader than long.....21

21. Mandibles at least one-fourth as long as the rest of the head, the basal tooth partly exposed..... *abdita*

Mandibles not more than one-sixth as long as the rest of the head, the basal tooth completely covered 22

22. Middle of the clypeus depressed, its posterior portion rising suddenly to the level of the frontal lobes 23
Middle of the clypeus not depressed, evenly sloping from its anterior edge to the level of the frontal lobes 24

23. Each lateral border of the clypeus with three prominent, spoon-shaped hairs which are curved toward the rear of the head ..... *reflexa*
Each lateral border of the clypeus with four to six hairs which are spatulate but scarcely spoon-shaped and which curve forward ..... *sculpturata*

24. Upper half of the head rugulose or tuberculate; mandibles stout with their outer margins rather strongly convex ..... *missouriensis*
Upper half of the head reticulo-punctate; mandibles slender, their outer margins feebly convex ..... *pulchella*

Subgenus STRUMIGENYS F. Smith

1. STRUMIGENYS LOUISIANAE Roger

S. louisianae Roger, Berl. Ent. Zeitschr., Vol. 7, p. 211 (1863) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 327 (1895) ♀; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 689, pl. 1, fig. 1 (1931) ♀.

S. unispinulosa Emery, Bull. Soc. Ent. Ital., Vol. 22, p. 67, pl. 7, fig. 5 (1890) ♀ ♀.

Type loc: Louisiana. Types: none in this country.

Range: Florida to Texas and south into Mexico.

2. STRUMIGENYS LOUISIANAE LATICEPHALA M. R. Smith

S. louisianae subsp. *laticephala* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 690, pl. 1, fig. 2 (1931) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 548, pl. 14, fig. 52 (1947) ♀.

Type loc: Longview, Mississippi. Types: Coll. M. R. Smith, Coll. Dept. Ent. A. & M. Coll. Miss.

Range: Mississippi through the eastern Gulf States and north to the Carolinas.

It seems proper to consider *laticephala* as a northern race of *louisianae*. The two forms have a considerable area of overlap in the Gulf Coast region but *laticephala* occurs in northern stations where the typical form is absent. The reverse is also true, for there are as yet no records of *laticephala* from Texas, although the typical form occurs there.

Subgenus TRICHOSCAPA Emery

3. STRUMIGENYS (TRICHOSCAPA) ABDITA L. G. & R. G. Wesson

S. (*C.*) *abdita* L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 106, pl. 3, fig. 6 (1939) ♀.
Type loc: Jackson, Ohio. Type: M.C.Z., Paratypes: Coll. Wessons.
Range: known only from the three type specimens.

4. STRUMIGENYS (TRICHOSCAPA) ANGULATA M. R. Smith

S. (*C.*) *angulata* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 697, pl. 1, fig. 3 (1931) ♀.
Type loc: Louisville, Mississippi. Types: Coll. M. R. Smith, M.C.Z., Coll. Dept. Ent. A. & M. Coll. Miss.
Range: known only from type material.

5. STRUMIGENYS (TRICHOSCAPA) BIMARGINATA L. G. & R. G. Wesson

S. (*C.*) *bimarginata* L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 95, pl. 3, fig. 2 (1939) ♀.
Type loc: Cedar Mills, Adams County, Ohio. Type: M.C.Z.
Range: Ohio south to Alabama.

6. STRUMIGENYS (TRICHOSCAPA) BREVISETOSA M. R. Smith

S. (*C.*) *clypeata* var. *brevisetosa* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 28, p. 215 (1935) ♀.
Type loc: Lucedale, Mississippi. Type: Coll. M. R. Smith.
Range: known only from type material.

This insect cannot be regarded as a subspecific variant of *clypeata*, for it occurs in the same area with *clypeata*. It appears to be quite as distinct as several other forms which have been given specific status and, until more material is available, it seems best to treat *brevisetosa* as a species.

7. STRUMIGENYS (TRICHOSCAPA) CLYPEATA Roger

S. clypeata Roger, Berl. Ent. Zeitschr., Vol. 7, p. 213 (1863) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 571 (1887) ♀; Emery, Bull. Soc. Ent. Ital., Vol. 22, p. 325, pl. 8, fig. 3 (1890) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 328, pl. 8, figs. 21, 22 (1895) ♀ ♀ ♂.
S. (*C.*) *clypeata* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 699, pl. 3

fig. 9 (1931) ♀; L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 93 (1939) ♀.

Type loc: Louisiana. Types: none in this country.

Range: the entire southeastern United States north to Pennsylvania and west to Illinois.

There has been confusion regarding the type material of *clypeata*. This species was described by Roger from specimens taken in Louisiana. When Weber described *talpa* in 1934 he cited two specimens of *clypeata* in the collection of the Museum of Comparative Zoölogy as cotypes. These two insects were taken at Beatty, Pennsylvania, hence they are not cotypes. They seem to be a part of the series of specimens on which Emery based his redescription and figure of *clypeata* which was published in 1895. There is little doubt that they are authentically determined, since Emery had specimens of *clypeata* from Roger. But Weber's citation is both incorrect and confusing in view of the general assumption that most of Roger's types no longer exist.

I have removed from *clypeata* the varieties *brevisetosa* M. R. Smith, *pilinasis* Forel and *laevinasis* M. R. Smith. My reasons for these changes are discussed under the forms involved.

8. Strumigenys (Trichoscapa) creightoni M. R. Smith

S. (*C.*) *creightoni* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 705, pl. 4, fig. 16 (1931) ♀.

Type loc: Spring Hill, Mobile, Alabama. Types: Coll. M. R. Smith.

Range: southern Alabama to eastern Tennessee.

9. Strumigenys (Trichoscapa) dietrichi M. R. Smith

S. (*C.*) *dietrichi* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 696, pl. 2, fig. 6 (1931) ♀; L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 93 (1939) ♀.

Type loc: Lucedale, Mississippi. Types: Coll. M. R. Smith, Coll. Dept. Ent. A. & M. Coll. Miss.

Range: Mississippi and Alabama north to Ohio.

10. Strumigenys (Trichoscapa) margaritae Forel

S. margaritae Forel, Trans. Ent. Soc. Lond., p. 378 (1893) ♀ ♀ ♂; Emery, Bull. Soc. Ent. Ital, Vol. 26, pl. 1, fig. 6 (1894) ♀.

S. (*C.*) *margaritae* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 692, pl. 2, fig. 7 (1931) ♀.

Type loc: St. Vincent, West Indies. Types: A.M.N.H., M.C.Z.
Range: all records for this Antillean species coming from the United States have been confined to Texas.

11. Strumigenys (Trichoscapa) membranifera similima Emery

S. membranifera subsp. *simillima* Emery, Bull. Soc. Ent. Ital., Vol. 22, p. 69, pl. 8, fig. 5 (1890) ♀.
S. (*C.*) *membranifera* subsp. *simillima* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 693, pl. 3, fig. 10 (1931) ♀.
S. (*C.*) *membranifera* var. *marioni* Wheeler, Proc. Hawaiian Ent. Soc., Vol. 8, No. 2, p. 276 (1933) ♀.
Type loc: St. Thomas, Virgin Islands. Types: none in this country.
Range: eastern Gulf States.

There is no possible justification for Wheeler's recognition of the variety *marioni*. Wheeler set up this variety from specimens identified as the typical *simillima* by M. R. Smith. These had been compared by Dr. Smith with a cotype of *simillima*. Dr. Wheeler had no cotype of *simillima*, but relied on topotypes as the basis for his comparison. It is interesting to note Dr. Wheeler's statement in regard to this matter. His observation is as follows:

'The distinguishing characters of the various forms of *simillima* are so slight that their precise taxonomic rank cannot be determined without additional material.'

Since Dr. Wheeler did not hesitate to set up the varieties *marioni* and *williamsi* with this observation in mind, about the only thing that was proved by their description is the low regard which Dr. Wheeler had for varietal status. Dr. Smith's view is far sounder and I have, therefore, placed the variety *marioni* in the synonymy of *simillima*.

12. Strumigenys (Trichoscapa) manni L. G. & R. G. Wesson

S. (*C.*) *manni* L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 97, pl. 3, fig. 3 (1939) ♀.
Type loc: Sinking Spring, Pike County, Ohio. Types: M.C.Z., Coll. Wessons, Coll. W. S. Creighton, Coll. Wm. L. Brown, Jr.
Range: known only from type material.

The structure of *manni* is remarkably like that of *ohioensis*. The shape of the clypeus and the dentition of the mandibles is practically identical in the two forms. The Wessons described the anterior edge of the clypeus of *manni* as 'rather sharply truncate' but this is certainly

not the case in the cotypes which I have examined. Both the mandibles and the clypeus of *manni* are covered with numerous hairs which obscure the finer details of structure. If these parts are covered by some liquid (such as carbon tetrachloride) which will cut down the refraction caused by the hairs, a much clearer notion of their structure may be secured. Under such circumstances the anterior edge of the clypeus of *manni* is fully as convex as that figured for *ohioensis* by Dr. Kennedy. Since about the only notable difference between these two insects appears to be the number and shape of the erect hairs on the clypeus, it is entirely possible that *manni* may prove to be a synonym when *ohioensis* is better known.

13. Strumigenys (Trichoscapa) medialis L. G. & R. G. Wesson

S. (*C.*) *medialis* L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 94, pl. 3' fig. 1 (1939) ♀.
Type loc: Beaver, Pike County, Ohio. Types: M.C.Z., Coll. Wessons.
Range: known only from type material.

14. Strumigenys (Trichoscapa) missouriensis M. R. Smith

S. (*C.*) *missouriensis* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 701, pl. 4, fig. 14 (1931) ♀; L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 101 (1939) ♀.
Type loc: Columbia, Missouri. Types: M.C.Z., Coll. M. R. Smith.
Range: Missouri east to Ohio.

15. Strumigenys (Trichoscapa) pilinasis Forel

S. clypeata var. *pilinasis* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 339 (1901) ♀.
S. (*C.*) *clypeata* var. *pilinasis* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 700, pl. 3, fig. 12 (1931) ♀.
Type loc: Washington, D.C. Types: none in this country.
Range: known only from the District of Columbia.

So little is known about this insect that it is difficult to deal with it. Nevertheless, I believe that the Wessons were correct in treating *pilinasis* as a separate species in the key which they published in 1939. My only objection is that the Wessons did not go far enough in this matter. If *pilinasis* deserves to be separated from *clypeata*, the same treatment must be accorded to *laevinasis*. The peculiar clypeal pilosity of the two forms is quite unlike that of *clypeata*. Moreover, there is nothing to indicate that either form can be treated as a subspecies

of *clypeata*. It may be admitted that we know extremely little about the range of either *pilinasis* or *laevinasis*, but we do know that both insects have been taken at stations within the range of *clypeata*. Under such circumstances it is difficult to see how either form can be regarded as a subspecies of *clypeata*. I have treated *lacvinasis* as a subspecies of *pilinasis*, since there is nothing in the distribution of the two insects that would, at present, negate this view. It is entirely possible, however, that additional data on distribution may make it necessary to give specific rank to *lacvinasis* also.

16. Strumigenys (Trichoscapa) pilinasis laevinasis M. R. Smith

S. (*C.*) *clypeata* var. *laevinasis* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 701, pl. 3, fig. 11 (1931) ♀.

Type loc: Louisville, Mississippi. Types: Coll. M. R. Smith, Coll. Dept. Ent. A. & M. Coll. Miss.

Range: known only from type material.

17. Strumigenys (Trichoscapa) ohioensis Kennedy & Schramm

S. ohioensis Kennedy & Schramm, Ann. Ent. Soc. Amer., Vol. 26, p. 98, fig. 3 (1933) ♀.

Type loc: Tuppers Plains, Meigs County, Ohio. Types: Coll. C. H. Kennedy.

Range: known only from Ohio.

18. Strumigenys (Trichoscapa) ornata Mayr

S. ornata Mayr, Verh. Zool-bot. Ges. Wien, Vol. 37, p. 571 (1887) ♀; Emery, Bull. Soc. Ent. Ital., Vol. 22, pl. 8, fig. 2 (1890) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 325, pl. 8, fig. 20 (1895) ♀.

S. (*C.*) *ornata* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 695, pl. 2, fig. 5 (1931) ♀; L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 92 (1939) ♀.

Type loc: Washington, D.C. Types: U.S.N.M.

Range: District of Columbia south to the eastern Gulf States and west to Ohio.

19. Strumigenys (Trichoscapa) pergandei Emery

S. pergandei Emery, Zool. Jahrb. Syst., Vol. 8, p. 326, pl. 8, figs. 17, 18 (1895) ♀ ♀ ♂.

S. (*C.*) *pergandei* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 698, pl. 1, fig. 4 (1931) ♀; L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 92 (1939) ♀.

Type loc: District of Columbia (by present restriction). Types: U.S.N.M., M.C.Z., A.M.N.H.
Range: northeastern United States and southern Ontario south to Virginia and west to Iowa.

20. Strumigenys (Trichoscapa) pulchella Emery

S. pulchella Emery, Zool. Jahrb. Syst., Vol. 8, p. 327, pl. 8, fig. 19 (1895) ♀.
S. (*C.*) *pulchella* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 702, pl. 4, fig. 13 (1931) ♀; L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 100 (1939) ♀.
Type loc: Washington, D.C. (by present restriction). Types: U.S.N.M.
Range: southern New York west to Iowa and south to the eastern Gulf States.

21. Strumigenys (Trichoscapa) reflexa L. G. & R. G. Wesson

S. (*C.*) *reflexa* L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 102, pl. 3, fig. 4 (1939) ♀.
Type loc: Jackson, Ohio. Type: M.C.Z., Paratypes: Coll. Wessons, A.M.N.H., Coll. W. S. Creighton.
Range: known only from type material.

22. Strumigenys (Trichoscapa) rohweri M. R. Smith

S. (*C.*) *rohweri* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 28, p. 214 (1935) ♀.
Type loc: Holly Springs, Mississippi. Types: U.S.N.M., Coll. M. R. Smith.
Range: known only from type material.

23. Strumigenys (Trichoscapa) rostrata Emery

S. rostrata Emery, Zool. Jahrb. Syst., Vol. 8, p. 329, pl. 8, fig. 23, 24 (1895) ♀.
S. (*C.*) *rostrata* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 704, pl. 2, fig. 8 (1931) ♀; L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 99 (1939) ♀.
S. (*T.*) *rostrata* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 584, pl. 14, fig. 54 (1947) ♀.
Type loc: Washington, D.C. Types: U.S.N.M., M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: New Jersey south to the eastern Gulf States and west to Ohio.

In 1931 Dr. M. R. Smith regarded the range of *rostrata* as covering much of the United States. This view was based on a record of this species from Claremont, California. Since all the other records of this species come from east of the Mississippi River, Dr. Smith's

conclusion appears very doubtful. It is more likely that the presence of *rostrata* in California may be due to its introduction into that state.

24. Strumigenys (Trichoscapa) sculpturata M. R. Smith

S. (*C.*) *sculpturata* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 24, p. 706, pl. 4, fig. 15 (1931) ♀.
Type loc: Aberdeen, Mississippi. Types: Coll. M. R. Smith, Coll. Dept. Ent. A. & M. Coll. Miss.
Range: Mississippi to southern New England.

25. Strumigenys (Trichoscapa) talpa Weber

S. (*C.*) *talpa* Weber, Psyche, Vol. 41, p. 63, fig. 1 (1934) ♀.
S. (*C.*) *venatrix* L. G. & R. G. Wesson, Psyche, Vol. 46, No. 2, p. 103, pl. 3, fig. 5 (1939) ♀.
Type loc: Herod, Illinois. Type: Coll. Ill. Nat. Hist. Soc.
Range: southern Alabama north to Illinois and Ohio.

Through the courtesy of Mr. W. L. Brown, Jr., I was able to compare the type of *talpa* with those of *venatrix*. Mr. Brown is of the opinion that the two insects are the same, and I agree with him. There can be no doubt that the Wessons were misled by Dr. Weber's figure of the head of *talpa*, for this figure gives the impression of a much wider head than is actually the case. It may be recalled that Dr. Weber described the clypeal hairs of *talpa* as 'narrow-squamose'. The hairs, particularly those at the margin of the clypeus, are slightly flattened and thickened distally. But this flattening is not great enough to show under ordinary magnification, and it is only under very high magnification that the clypeal hairs of *talpa* appear to be somewhat squamose.

Genus Cyphomyrmex Mayr

(Plate 40, figures 1–4)

The great majority of the species which belong to the genus Cyphomyrmex are distributed throughout tropical regions in Central America, South America and the Antilles. The two species which occur in the United States are found only in areas close to our southern boundary. One of these, *C. wheeleri*, is easy to handle, for it is marked by very distinct morphological characters and throughout its rather circumscribed range it has, apparently, produced no subspecific variants. One could wish that a similar clarity prevailed in the case of

rimosus, a single form of which occurs within our borders. But this widespread and highly variable species has been a focal point for errors and contradictions since the time of its description almost a century ago. So many myrmecologists have expressed opinions on the status of *rimosus* and its subspecies *minutus* that it is easy to become confused and misconstrue what has been said. This result has occurred in Dr. Weber's 1940 revision of Cyphomyrmex. In this revision, Dr. Weber proposes to synonymize the subspecies *minutus* with the typical *rimosus* and to show that his proposal has the support of other myrmecologists, he makes the following observation:

"Both Wheeler and Forel believed Mayr's *minutus* to be a synonym of *rimosus*, although they frequently recorded the West Indian Cyphomyrmex as *rimosus* ssp. or var. *rimosus*."

I find this statement disturbing, for it is largely contrary to fact. At no time did Wheeler ever propose to regard *minutus* as a synonym of *rimosus*, and there is abundant printed evidence to show that he considered the two as separate forms to the end of his life. In Forel's case there is more justification for Dr. Weber's statement. When Forel included *minutus* in the synonymy of *rimosus* in 1899, the treatment was that proposed six years earlier in Dalla Torre's Catalogue. In 1899 Forel was obviously unaware that Emery had published data in 1894 which made such a treatment impossible. As I shall show in the sequel, Forel was never fully acquainted with the nature of the *rimosus-minutus* problem. As a result, his judgement on this matter was of very limited value. I am sorry to say that much the same considerations apply to Dr. Weber's view. He, like Forel, has neglected the importance of certain observations made upon *rimosus* and *minutus* by Carlo Emery. In the following paragraphs I have traced the steps in the *rimosus-minutus* problem in the hope that a full account of this matter may enable myrmecologists to judge the merits of the various contentions more accurately.

In 1851 Spinola published the description of an ant which he called *Cryptocerus? rimosus*. The specimens on which he based this species were said to have come from Para, Brazil. Spinola's description is very imperfect and it may be doubted that anyone could have recognized the insect from it. Certainly Frederick Smith could not for, although he listed Spinola's species in 1853, he redescribed it as *Meranoplus difformis* nine years later. In that same year (1862) Mayr set up the genus Cyphomyrmex. As a basis for this genus Mayr had specimens, taken in Cuba, to which he gave the specific name *minutus*. This brought an immediate response from Roger who, in the following year, denied the validity of Cyphomyrmex, designated *minutus* as a synonym of Smith's *difformis* (which Roger

spelled '*deformis*') and shifted that species to the genus Cataulacus. While Mayr was willing to accept Roger's specific synonymy, he would not agree to sink the genus Cyphomyrmex. Thus, for many years, *minutus* appeared in myrmecological literature as *Cyphomyrmex deformis*.

In 1884 Forel described a species of Cyphomyrmex, which he called *steinheili*, from material taken in the Lesser Antilles. There can be no doubt that at that time Forel was unaware of the nature of Mayr's *minutus* for, as Mayr was able to show later, the two insects are identical. In 1893 Emery was invited to examine the collection of ants made by Spinola, which had been deposited in the Zoological Museum of Turin. From the brief paper which Emery published as a result of this examination it seems clear enough that a considerable part of his interest in Spinola's collection lay in the fact that it contained specimens identified by Latreille and Klug. Spinola's own species were all too plainly in bad shape. They were poorly, and in some cases erroneously, labelled. Thus the type of Spinola's *Cosmaecetus omalinus*, which proved to be a synonym of *Typhlopone fulvus*, bore a locality label marked Para, Brazil. This is an obvious impossibility, since *fulvus* is endemic to North Africa and Asia minor. Emery could find no specimens labelled *Cryptocerus? rimosus* for the space so marked in the cabinet was bare. He found, however, some specimens labelled *Myrmica rimosus*, apparently without any other data attached, which he regarded as the "same thing" (the phrase Emery employed is "la stessa cosa"). It is possible to argue that Emery could not be sure that the specimens of *Myrmica rimosus* were the same as those from which *Cryptocerus? rimosus* was described. But if this stand is taken, then *rimosus* must be relegated to the limbo of unrecognizable species and the name replaced by *difformis*. Conversely, if we are to continue to use the name *rimosus*, we must not only agree with Emery's association but also accede to his definition of the characteristics of that species. For of the various myrmecologists who have expressed opinions as to the nature of the typical *rimosus*, Emery and Emery alone, has examined the only specimens which may be regarded as authentic.

Emery not only examined the Spinola specimens carefully but also managed to secure a male from the series which he took home for further examination and comparison with material in his own collection. As a result of these studies Emery published in the following year (1894) an arrangement of the *rimosus* complex which greatly clarified the matter. In this arrangement *difformis* was made a synonym of *rimosus*. Forel's *steinheili* became a synonym of *minutus*, which was made a subspecies of *rimosus*. In addition, Emery de-

scribed two new variants, the subspecies *transversus* and a variety which he called *fuscatus*. To authenticate this arrangement Emery presented several structural differences by which the typical *rimosus* could be separated from the subspecies *minutus*. In the worker of the typical *rimosus* the second node of the petiole is only a little broader than long and the teeth of the thorax are strong and acute, particularly the lateral pair on the pronotum. In the subspecies *minutus* the second node of the petiole is almost half again as broad as long and noticeably broader than the preceding joint. The teeth or tubercles of the thorax are smaller and less acute than those of the typical form, particularly those at the rear of the epinotum, which are so reduced as to be scarcely noticeable. These distinctions appear to be clear enough but it is never easy to reëstablish a form which has long been treated as a synonym and *minutus* had been thus obscured for more than a quarter of a century. Perhaps this is why, when Forel dealt with *rimosus* in the formicid section of the *Biologia Centrali Americana* (1899), he made no clear distinction between the typical form and the subspecies *minutus*. Nor was the situation any better in 1901, when Forel redescribed the subspecies *transversus* under the name *olindanus*. Since *transversus* is a very distinct form and since Emery described it not only in the same paper but on the same page which carried his diagnostics for *minutus*, it seems clear enough that Forel had made little effort to benefit by Emery's studies. But Forel's refusal to recognize *minutus*, or his inability to do so, by no means invalidates the basis on which that subspecies rests. Emery's stand is a sound one and Wheeler was perfectly aware of this, for he repeated the substance of Emery's observations in his 1907 study. It was in this paper that Wheeler stated that he had some doubt as to whether *minutus* deserved to rank as a subspecies. This statement appears to be the point of departure from which Dr. Weber arrived at the very different pronouncement quoted in an earlier paragraph. During the next thirty years, Wheeler cited *minutus* on many occasions but, except for one time when he referred to it as a variety (1913), he invariably treated it as a subspecies of *rimosus*.

I have undertaken this involved presentation because I cannot agree with Dr. Weber that *minutus* is a synonym of the typical *rimosus*. I am more than ready to agree that the same form of this insect is widely distributed throughout the Antilles and the tropical portions of continental America. But where Dr. Weber regards this widely distributed form as the typical *rimosus*, I believe that it is actually the subspecies *minutus*. There seems to be little possibility for error in this matter, since the form referred to is the only one which occurs in Cuba, from which island the types of *minutus* came. Yet

Dr. Weber utilizes this fact as his principal reason for synonymizing the two forms. Since he can see no difference of any significance between the insular specimens (which are obviously *minutus*) and those from the continent, which he regards as the typical *rimosus*, the two must be synonyms. But Dr. Weber gives no reason why the common continental form must be regarded as the typical *rimosus*. Emery stated clearly that the teeth on the thorax of that form are well-developed, yet in Dr. Weber's plate the thorax of the insect which he regards as the typical *rimosus* is the least spinose of any figured and corresponds remarkably to Emery's description of the thorax of *minutus*. The same may be said for the characteristics of the "typical *rimosus*" which Dr. Weber has given in his key. I repeat that I believe that Dr. Weber's "typical *rimosus*" is actually *minutus* and I further believe that he, in company with other myrmecologists, has either not seen the typical *rimosus* or else has assigned it to some other subspecies. For there seems to be no end to the array of continental variants which have been described as subspecies of *rimosus*. Several of these with well-developed, acute thoracic teeth (*salvini, trinatatis, dentatus* etc.) appear to be very similar to the insect that Emery described as the typical *rimosus*. Finally, I believe that instead of synonymizing *minutus* with *rimosus*, it may subsequently prove to be a separate species. For it is clear that all of the present welter of subspecies assigned to *rimosus* cannot properly be treated as such. Since two or more may occur in the same stations, the possibility for treating them as geographical races is considerably limited. No doubt there are a number of true geographical races present in the complex but they cannot all be assigned to the same species. I would venture the opinion that there are several sibling species involved in the *rimosus* complex as it is constituted at present and when the situation is more fully resolved, *minutus* will be found to be one of them. In this connection it is of interest to observe that in 1925 Wheeler published the statement that in his opinion the subspecies *transversus* and *salvini* might properly be regarded as distinct species. Since the elevation of *minutus* to specific rank will necessitate a broad revaluation of the *rimosus* complex, I have continued to treat this insect as a subspecies in this work.

In the case of most attine genera the habit differences between species belonging to the same genus are usually slight. Cyphomyrmex, on the other hand, possesses a number of species whose habits differ to an extent which makes generalization difficult. It is possible, however, to note certain similarities which seem to prevail in most of the species. Much of the data presented below is taken from Wheeler's 1907 monograph of the Attini. The colonies of Cyphomyrmex are

invariably small, rarely consisting of more than two hundred individuals and often of a much smaller number. The larger colonies usually possess two or three queens. The ants are slow of movement, very timid and readily feign death if disturbed. According to Wheeler, the females feign death as readily as the workers but the males are less apt to do so. The nests are usually constructed under some covering object such as a stone, a small log or a piece of wood. Both passages and chambers are less neatly built and more irregular than those of other attine groups. The passages and the fungus chambers as well, may be built directly against the lower surface of the covering object or sunk a few centimeters in the soil below the covering object.

There is usually a single nest opening at one side of the covering object and this opening is sometimes surrounded by an obscure crater of excavated soil. The various species appear to grow distinctly different kinds of fungi and there is little uniformity as to the kinds of material on which the garden is grown. Thus the fungus garden of *wheeleri* consists of a glistening, white mycelium which is nourished with slivers of vegetable tissue thrust directly into the garden without previous trituration. That of *rimosus* subsp. *minutus* does not appear to be a mycelium at all but consists of isolated clumps of bromatia. This fungus is grown on collected caterpillar droppings which are heaped in a small pile and kept extremely moist. In some nests the droppings are placed on a small dead leaf or flattened pebble which may prevent the moisture which covers them from draining into the soil below. The brood is not placed in the fungus garden but piled to one side of it. In both *wheeleri* and *minutus* the fungus garden lies on the floor of the chamber but this practice is not uniform throughout the genus for Weber (1940) has shown that in *columbianus* the fungus garden is suspended from a root. Weber has also presented evidence to show that the female of that species leaves the nest to forage for material on which the original garden is grown. This important observation is the second report of such activity on the part of a nest founding attine female. It may be recalled that Cole in 1939 published an account of similar behavior in the female of *Trachymyrmex septentrionalis* subsp. *seminole*.

It is my opinion that Wheeler's variety *comalensis* is a synonym of *minutus*. It is clearly related to that subspecies rather than to the typical *rimosus* both in the structure of the petiolar nodes and the character of the thoracic projections. About the only feature by which the two might be distinguished is the color of *comalensis*, which appears to be more uniform than is often the case with that of the colonies of *minutus*. But it should be noted that there is no difference in the coloration of *comalensis* and that of the darker individuals present in

the colonies of *minutus*. I consider this very slight and probably inconstant difference as insufficient to justify separate status for *comalensis*. If this interpretation is correct, there are only two members of the genus Cyphomyrmex which occur in the United States, the species *wheeleri* and *rimosus* subsp. *minutus*. The two may be separated as follows:

Key to the species of Cyphomyrmex

Tips of the antennal scapes reaching but not surpassing the posterior corners of the head; node of the petiole with two rather slender teeth on its dorsal surface; length 2–2.5 mm. ..... *wheeleri*

Tips of the antennal scapes surpassing the posterior corners of the head by an amount approximately equal to their greatest diameter; node of the petiole without teeth on its dorsal surface; length 1.8–2 mm. . *rimosus* subsp. *minutus*

1. Cyphomyrmex rimosus minutus Mayr

Cyphomyrmex minutus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 691 (1862) ♀.

Cataulacus deformis Roger, Berl. Ent. Zeitschr., Vol. 7, p. 210 (1863) ♀ ♂.

Cyphomyrmex deformis Mayr (part), Verh. Zool-bot. Ges. Wien, Vol. 37, p. 558 (1887) ♀ ♀ ♂.

C. rimosus subsp. *minutus* Emery, Bull. Soc. Ent. Ital., Vol. 26, p. 225 (1894) ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 106, figs. N, O (1905) ♀; Wheeler, Ibid., Vol. 23, p. 722 (1907) ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 586, pl. 15, fig. 55 (1947) ♀.

C. rimosus Forel, Trans. Ent. Soc. Lond., p. 374 (1893); Forel, Biol. Centrali Amer. Hym., Vol. 3, p. 40 (1899); Weber, Revista Entomol., Vol. 11, p. 410, figs. 3, 10 (1940) ♀ (*nec rimosus* Spinola).

C. rimosus var. *comalensis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 719, pl. 49, fig. 1 (1907) ♀ ♀ ♂.

C. steinheili Forel, Bull. Soc. Vaud. Sci. Nat. (2) Vol. 20, p. 368 (1884) ♀.

Type loc: Cuba. Types: none in this country.

Range: widely distributed throughout the Antilles and the portions of the continents which adjoin the Gulf of Mexico and the Caribbean Sea. In the United States the insect is found only in southern Florida and the southern part of Texas.

2. Cyphomyrmex wheeleri Forel

C. wheeleri Forel, Mitt. Schweiz. Ent. Ges., Vol. 10, p. 282 (1900) ♀ ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 527, pl. 49, fig. 2 (1907) ♀ ♀ ♂; Weber, Revista Entomol., Vol. 11, p. 409 (1940) ♀.

Type loc: Austin, Texas. Types: M.C.Z.

Range: south central to western Texas and southern California.

In 1907 Wheeler believed that the range of this species extended westward from Texas to California and also entered northern Mexico. Although this supposition is entirely logical, there are still no published records to support it. On the contrary, much collecting in southern Arizona has seemed to show that *wheeleri* is absent or exceedingly rare in that region. The distributional characteristics of *wheeleri* are likely to remain problematical until more is known of the ants of the northern provinces of Mexico. It is clear, however, that *wheeleri* is much more xerophilous than *minutus* and this must certainly have a bearing on its distribution.

Genus MYCETOSORITIS Wheeler

In the present work I have accorded generic status to Mycetosoritis. It seems that no other course is possible if we are to strive for consistency in the treatment of the attine genera. I have explained elsewhere (see the discussion under the genus Atta) that these genera intergrade to a much greater extent than is commonly the case in other formicid groups. It need, therefore, occasion no difficulty that Mycetosoritis is plainly transitional between Trachymyrmex and Cyphomyrmex. When Wheeler described *Mycetosoritis hartmanni* in 1907 he made it a subgenus of Atta. Later he decided that it was more properly considered a subgenus of Trachymyrmex. It appeared as a subgenus in Emery's expanded version of the genus Cyphomyrmex and, since Emery also included Trachymyrmex as a subgenus of Cyphomyrmex, his arrangement showed a congruous relation between the three groups involved. But while neither of the above authorities saw fit to treat Mycetosoritis as a genus, both advocated the recognition of other attine genera on structural distinctions which are little if any better than those which mark Mycetosoritis. If Acromyrmex and Trachymyrmex are to be treated as genera, it is no more than consistent to accord generic status to Mycetosoritis also. Moreover such a treatment appears to be the only one which will relieve the problem of what to do with Mycetosoritis, for as long as it remains a subgenus it must be assigned either to Trachymyrmex or to Cyphomyrmex. But its inclusion in either genus is unsatisfactory, since it breaks down what might otherwise be rather clear cut generic diagnostics. For in the worker of Trachymyrmex the antennal lobes, though large, are rounded in front and do not project forward above the anterior border of the clypeus. The body hairs are erect and curved or hooked at the end and many of them, especially those on the head and gaster, arise from small but distinct tubercles. The

thorax bears a number of well-developed spines which are usually slender and only rarely have the form of conical teeth. In Cyphomyrmex the antennal lobes project well forward, so that their pointed tips overhang the anterior border of the clypeus. The body hairs are appressed, flattened and usually scale-like, never curved or hooked. These hairs very rarely arise from tubercles. The thorax is variously ornamented with laminae, ridges or bosses which may have sharp tips but these tooth-like projections rarely resemble spines, although the term is often applied to them. In Mycetosoritis the antennal lobes are large and overhang the clypeus. The thorax bears short, pointed teeth or connules. The suberect body hairs are curved and those on the gaster arise from tubercles, although there are comparatively few tubercles elsewhere on the body. To include such an obviously transitional species in either genus weakens the distinctions by which they may be separated. If we wish to maintain Trachymyrmex and Cyphomyrmex as separate genera, the safest plan is to give Mycetosoritis full generic rank for, if it is made a subgenus of Cyphomyrmex, there is no clear break between Cyphomyrmex and Trachymyrmex. As far as habits are concerned Mycetosoritis might be included in either genus but does not fit either overly well. It constructs a suspended fungus garden (a habit more frequently met with in Trachymyrmex) which is grown on untriturated plant material (a characteristic often met with in Cyphomyrmex). But this plant material has a unique character for it consists entirely of the withered anthers of flowers. In this respect Mycetosoritis corresponds to no other known attine and, if this unusual choice of material is a consistent one, Mycetosoritis is marked by a distinct habit pattern of its own.

Of the two species of *Mycetosoritis* which have been described, only one, *M. hartmanni*, occurs in the United States.

1. Mycetosoritis hartmanni Wheeler

Atta (*M.*) *hartmanni* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 714, pl. 49, figs. 6, 7 (1907) ♀ ♀ ♂.

Cyphomyrmex (*M.*) *hartmanni* Emery, Ann. Soc. Ent. Belg., Vol. 57, p. 251 (1913); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 588, pl. 15, fig. 56 (1947) ♀.

Type loc: Montopolis and Delvalle, Texas. Types: M.C.Z.

Range: known only from type material.

Genus TRACHYMYRMEX Forel

(Plate 41, figures 1–4)

There are several reasons why the North American representatives of the genus Trachymyrmex offer exceptionally good material to those interested in the biology of the fungus-growing ants. Although their colonies are far less spectacular than the huge formicaries of the genus Atta, their range in America north of Mexico is incomparably greater. This is largely because of the widespread distribution of *septentrionalis*, a species whose range extends from Texas to southern New York. Throughout much of this range *septentrionalis* is surprisingly abundant but it is often overlooked since it is a timid and unaggressive species with rather inconspicuous nesting habits. But here again these characteristics facilitate observation. There is none of the difficulty which one encounters with a large Atta colony where the inhabitants are usually so active and pugnacious that close observation is unpleasant or impossible without first killing off most of the inhabitants of the nest.

The habits of our species of Trachymyrmex, particularly *septentrionalis*, have been repeatedly observed. As early as 1880, both Morris and McCook had published observations on the habits of *septentrionalis* but these early accounts contained many inaccuracies. Neither of these observers recognized the true nature of the fungus gardens and it was not until 1896 that these were correctly interpreted by Swingle. Two very extensive accounts of the biology of these insects were published by Wheeler in 1907 and 1911. The most recent publication is that of Cole, who added some interesting data in a paper which appeared in 1939. It is impossible here to do more than present a summary of the material carried in the above papers.

All the species of Trachymyrmex which occur in the United States form small colonies. In *T. arizonensis*, whose nests are the largest of any of our species, there may be as many as a thousand workers present. But the number is usually much smaller and many of the nests of *septentrionalis* and *turrifex* consist of only a few dozen individuals. These ants are decidedly timid and rather slow of movement. The foraging workers are apt to feign death if disturbed and even when the nest is broken open they usually make little attempt to resist the intruder. The form of the nest is remarkably constant considering the widely different situations in which they are built. Although the soil at the surface of the ground may be friable and crumbly, the chambers which contain the fungus gardens are always constructed in hard packed soil, sand or gravel. The chambers, which are roughly

ovoid and at most a few inches in diameter, are connected by unbranched passages. If the nests are constructed in areas where trees or shrubs are growing, each of the chambers contains one or more rootlets of these plants which have been left intact during the excavation and which serve as an anchorage to which the fungus garden is originally attached. In some cases these roots are pendant from the roof of the chamber; in others they run through the chamber from side to side. If plant roots are not present, as is often the case when the nests are established in open desert areas, the fungus garden is attached directly to a stone in the roof of the chamber. The fungus garden is grown on comminuted caterpillar excrement, or plant tissue or a mixture of the two. The nest is often surmounted by various types of excavated or built up structures. In *septentrionalis* there is usually a crescent-shaped mass of sand about the nest opening and in the center of this partial crater there may be a smaller circle of bits of vegetable detritus. In *turrifex* a chimney one or two inches high and constructed of earth particles and vegetable detritus usually surmounts the nest opening. Wheeler was of the opinion that this chimney was a specific pecularity found only in *turrifex* but Cole has shown that similar structures are occasionally built by *septentrionalis*. The nests of the desert-dwelling species usually lack any surmounting structure, although the opening may be surrounded by bits of old, discarded fungus gardens. The nest openings are often closed by the ants during periods of heat and drought, apparently to conserve moisture in the chambers containing the fungus gardens.

The colony may contain one or several deälated females. The number of queens present appears to have little to do with the size of the colony for the small colonies of *turrifex* regularly contain several queens. According to Cole the nest-founding female of *septentrionalis* subsp. *seminole*, after constructing a single, small chamber, forages outside the nest for materials on which the original fungus garden is grown. If this is true of the other species of Trachymyrmex it affords a significant habit difference between this genus and Atta. For in *Atta sexdens*, and presumably in the other species as well, the female practices the claustral type of nest-founding and nourishes the first fungus garden with her own excrement and broken and macerated eggs taken from the brood.

The following key has been modified from the key to the genus which was published by Wheeler in 1911.

Key to the species of Trachymyrmex

1. Preorbital carina not curved mesially and not crossing the antennal scrobe but continued backward to the posterior corner of the head.....2

Preorbital carina curved inward and crossing or at least entering the antennal scrobe and not extending to the posterior corner of the head.....3

2. Color ferrugineous; gaster with a feebly developed median dorsal impression and lateral ridges; length 3–3.75 mm.....*turrifex*
Color brownish yellow; gaster without median dorsal impression or lateral ridges; length 2.5–2.8 mm.....*turrifex* subsp. *caroli*

3. Lateral projections of the promesonotum forming rough, rather flattened cones, distinctly not spine-like.....*desertorum*
Humeral angles of the pronotum with distinct spines which are longer than those on the remainder of the promesonotum, at least some of the latter spine-like, not conical.....4

4. Posterior corners of the head each with a cluster of rather slender tubercules with blunt tips and all of about the same length.....*arizonensis*
Posterior corners of the head each with one prominent bidentate tubercle and several shorter and smaller tubercles which are not bidentate.....5

5. Color brownish yellow; surface of the body rather smooth and slightly shining; spines slender.....*septentrionalis*
Color ferrugineous to blackish brown; surface of the body distinctly granular and opaque; spines stouter.....6

6. Length 3–3.5 mm.; infuscation of the front and gastric dorsum feeble....
septentrionalis subsp. *obscurior*
Length 3.5–4 mm.; infuscation of the front and gastric dorsum distinct..
septentrionalis subsp. *seminole*

1. Trachymyrmex arizonensis (Wheeler)

Atta (*T.*) *arizonensis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 710, pl. 49, figs. 9, 10 (1907) ♀ ♂; Wheeler, Psyche, Vol. 18, p. 93, fig. 1 (1911) ♀.

Type loc: Huachuca Mts., Arizona. Types: M.C.Z., A.M.N.H.

Range: known only from the Huachuca Mountains where it occurs at elevations between 5000 and 6000 feet.

2. Trachymyrmex desertorum (Wheeler)

Atta (*T.*) *desertorum* Wheeler, Psyche, Vol. 18, p. 98, fig. 2 (1911) ♀.

Type loc: Carnegie Desert Lab., Tucson, Ariz. Types: M.C.Z.

Range: known from type material only.

3. Trachymyrmex septentrionalis (McCook)

It is necessary to use considerable caution in evaluating some of the variants described by Wheeler as belonging to this species. He himself was by no means satisfied as to the validity of the varieties *irrorata* and *crystallina* at the time when he described them. The

characteristic which distinguishes both these forms is the presence of small granules or crystals on the surface of the integument. Wheeler described the crystals and granules as a layer covering the surface uniformly but this is certainly not correct. I have examined the type specimens carefully and experimented with some which Dr. Wheeler gave me many years ago. In order to appreciate the actual disposition of the crystals or granules it is necessary to use a very high magnification and illuminate the surface obliquely. If this is done the crystals or granules appear as regularly spaced, minute, white dots projecting above the surface. Their appearance very strongly suggests that they are caps of foreign material sitting on the tops of small projections from the surface of the chitin. It may be recalled that Wheeler attempted to dissolve the granules by immersing the specimens in sodium hydroxide. This treatment failed to produce any change and, strangely enough, Wheeler concluded that the accretions were probably of a fatty consistency "apparently analogous to the waxy secretions covering the bodies of senescent dragon flies —". If these accretions are waxy, it is hard to understand why they were unaffected by the sodium hydroxide bath but this result would be expected if they are calcareous or alkaline in character. That they are of this nature seems to be clear, for if a dilute solution of acetic acid is brushed onto the surface of the insect, it dissolves the accretions in a very short time. It is then possible to see that the surface of the chitin between the piligerous tubercles is not uniformly granulose but is thrown up into very tiny subtubercles at regular intervals. The accretions form a cap on top of the subtubercles. It may be added that the same subtubercles are present in all forms of *septentrionalis* (and other species as well) and they frequently carry crystalline deposits at their tips. The type series of the subspecies *seminole* contains many specimens in which this condition occurs. About all that can be said for the varieties *crystallina* and *irrorata* is that they are more uniformly encrusted than is ordinarily the case. In my opinion this condition is not due to a temporary physiological condition, or to the age of the specimen as Wheeler supposed, but simply to the wetting of the insects by soil water heavily charged with calcium or alkaline salts. When such water dries, the dissolved salts are deposited on the surface of the body. The initial deposition appears to cover the entire surface but later this wears away, remaining last of all on the tips of the small subtubercles. The bluish bloom which Wheeler observed in several of the ergatotypes of *arizonensis*, and which he attributed to the age of the specimens, is due to this cause. His specimens were taken during a period of drought when some of the nest chambers were dust dry. Under such circumstances only an occasional worker would

have retained the deposit from the last wetting. In the late summer of 1932 I collected many colonies of *arizonensis* in the type locality just after a period of heavy rainfall. The great majority of the workers were completely covered with a very heavy bloom and in certain colonies the entire population was so colored. This crystalline deposit could be readily removed by weak acids, as described above, which restored the ordinary color and surface texture to the specimens thus treated. To return to the varieties *crystallina* and *irrorata*, there is absolutely no basis on which these forms can be recognized and I propose to regard both as synonyms of the typical *septentrionalis*.

The variety *vertebrata* presents a different problem. This is a slightly smaller and darker variant of the typical *septentrionalis*. If it had come from a more southern station, say southwestern Virginia or eastern Tennessee, it could pass for an intergrade between the typical *septentrionalis* and the subspecies *obscurior*. But unfortunately it was taken at Lakehurst, N.J., only ten miles from Toms River, the type locality of the typical form. There is nothing to indicate that there is any difference, either ecological or geographical which would distinguish *vertebrata* from the typical *septrentionalis*. Since the slight structural differences which separate the two are assuredly not great enough to be used as a basis for specific separation, it seems best to treat *vertebrata* as a nest variety of no significance and reduce it to a synonym of the typical form. Wheeler's varieties *obscurior* and *seminole*, on the other hand, appear to be geographical races. The former occurs in Texas and the south central states. The latter is widely distributed in Florida, the eastern Gulf states and the Carolinas. I would, therefore, arrange the *septentrionalis* complex as follows:

T. septentrionalis McCook
= var. *vertebrata* Wheeler
subspecies *obscurior* Wheeler
= var. *irrorata* Wheeler
= var. *crystallina* Wheeler
subspecies *seminole* Wheeler

There follows the synonymy of *Trachymyrmex septentrionalis* McCook:

Atta septentrionalis McCook, Proc. Acad. Nat. Sci. Phila., p. 359 (1880) ☿.
A. (*T.*) *septentrionalis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 706, pl. 49, fig. 4 (1907) ☿ ♀ ♂; Wheeler, Jour. N. Y. Ent. Soc., Vol. 19, p. 245 (1911) ☿ ♀.
A. (*T.*) *septentrionalis* var. *vertebrata* Wheeler, Ibid., Vol. 19, p. 246 (1911) ☿ ♀.
A. (*Acromyrmex*) *tardigrada* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 20, p. 91 (1884) ☿ ♀ ♂.

Type loc: Island Heights, Toms River, New Jersey. Types: none known to exist.

Range: southern New York (Long Island and Staten Island) south to the Carolinas and west to Ohio. In North Carolina the insect occurs at inland stations. Along the coast it is replaced by the subspecies *seminole*.

4. Trachymyrmex septentrionalis obscurior (Wheeler)

Atta (*T.*) *septentrionalis* subsp. *obscurior* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 709 (1907) ♀ ; Wheeler, Jour. N. Y. Ent. Soc., Vol. 19, p. 246 (1911) ♀ ♀.

A. (*T.*) *septentrionalis* subsp. *obscurior* var. *crystallina* Wheeler, Ibid., Vol. 19, p. 247 (1911) ♀ ♀ ♂.

A. (*T.*) *septentrionalis* subsp. *obscurior* var. *irrorata* Wheeler, Ibid., Vol. 19, p. 247 (1911) ♀.

Type loc: Austin, Texas (by Wheeler's 1911 designation). Types: M.C.Z.

Range: central Texas and Louisiana and northward through the Mississippi Valley.

5. Trachymyrmex septentrionalis seminole (Wheeler)

Atta (*T.*) *septentrionalis* subsp. *obscurior* var. *seminole* Wheeler, Jour. N. Y. Ent. Soc., Vol. 19, p. 247 (1911) ♀ ♀ ♂.

T. septentrionalis subsp. *obscurior* var. *seminole* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 590, pl. 16, fig. 59 (1947) ♀.

Type loc: Miami, Florida. Types: M.C.Z., Coll. W. S. Creighton.

Range: Florida and the eastern Gulf States and northward along the Atlantic Seaboard to the Carolinas.

6. Trachymyrmex turrifex (Wheeler)

Atta (*T.*) *turrifex* Wheeler, Psyche, Vol. 10, p. 100, fig. 6a (1903) ♀ ; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 709, pl. 49, fig. 3 (1907) ♀.

Type loc: Austin, Texas (by present designation). Types: M.C.Z.

Range: central and western Texas.

7. Trachymyrmex turrifex caroli (Wheeler)

Atta (*T.*) *turrifex* subsp. *caroli* Wheeler, Jour. N. Y. Ent. Soc., Vol. 19, p. 248 (1911) ♀.

Type loc: Huntsville, Texas. Types: lost? (see below).

Range: known only from type material.

The writer has been unable to discover any types of *caroli* in the M.C.Z. and A.M.N.H. collections. Since the subspecies was based on only two worker types, it is possible that these have been misplaced and are still in existence. It seems very doubtful that *caroli* is a valid race but, until the types are rediscovered and additional material secured, there is little that can be done with this insect.

Genus ACROMYRMEX Mayr

Subgenus MOELLERIUS Forel

In both structure and habits the ants of the genus Acromyrmex show a close relationship to the genus Atta. The best structural criterion for the separation of the two groups appears to be the character of the radial cell in the winged castes. Emery states that this cell in Acromyrmex is never more than four times as long as broad, while in Atta it is at least six times as long as broad. This distinction appears to be exceptionally clear in all the species which the writer has been able to examine. But no such clarity exists in the case of the differences which are supposed to distinguish the workers of the two genera. In the genus Atta the worker possesses only two pairs of dorsal spines on the promesonotum. In Acromyrmex there are supposed to be at least three pairs of dorsal spines in that area. In most cases this is true, but there are a number of species of Acromyrmex in which the anterior pair of dorsal pronotal spines are reduced in size and in the case of the species *landolti* they are replaced by angular ridges which are not spine-like at all. The sexual phases of *landolti* seem to be unknown, hence it is impossible to say whether they are also transitional. But certainly on the basis of pronotal armature the worker of *landolti* might be placed in the genus Atta with perfect propriety. This difficulty gives little trouble to the student of North American ants, for our single species, *Acromyrmex* (*Moellerius*) *versicolor*, has three distinct pairs of pronotal spines and so differs sharply from *Atta texana*, where there are only two pairs present.

There are significant habit differences which distinguish these two insects in the field. The nests of *Acromyrmex versicolor*, while similar to those of *Atta texana*, are of notably smaller average size. The nests of *versicolor* possess fewer craters and a smaller number of chambers for the fungus gardens. These chambers are often constructed in coarse, rather gravelly soil near the surface of the ground. In *texana* the passages leading down to the chambers are single, in *versicolor* they are usually branched. Wheeler was of the opinion that *versi-*

color and its subspecies *chisosensis* are both much more xerophilous than *texana*. There can be no doubt that this view is correct in the case of the typical *versicolor*, which prefers nest sites of exceptional aridity. But I doubt that this is also true of the subspecies *chisosensis*. It may be recalled that Wheeler was never able to discover a colony of this insect in the field. The type specimens were dead workers taken from a spider web and the location of the single nest, later found by Williams, led Wheeler to suppose that *chisosensis* inhabits the very arid canyons on the southern slopes of the Chisos Mountains. When the writer visited this region in 1933 there had been an almost unbroken drought for the previous twenty-two months. The canyons on the southern slopes were incredibly dry and barren. But on the northern slopes the situation was somewhat better and there, in a timbered area at considerable elevation, two nests of *chisosensis* were discovered. From this very limited data I would incline to the view that *chisosensis* is less xerophilous than the typical *versicolor*. We need more data before any certain conclusion can be reached about the nest site preference of this interesting ant.

Key to the subspecies of Acromyrmex (Moellerius) versicolor Pergande

Cephalic sculpture heavy and dense, the surface opaque; color deep, reddish brown ..... *versicolor*
Cephalic sculpture not dense enough to produce a completely opaque surface; color yellow ..... *versicolor* subsp. *chisosensis*

1. Acromyrmex (Moellerius) versicolor (Pergande)

Atta versicolor Pergande, Proc. Calif. Acad. Sci. (2), Vol. 4, p. 31 (1893) ♀.
Acromyrmex (M.) versicolor Emery in Wytsman, Genera Insectorum, Fasc. 174, p. 351 (1922).
Atta (M.) versicolor Emery, Mem. Soc. Accad. Bologna (6), Vol. 2, p. 108 (1905) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 703, pl. 49, fig. 5 (1907) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 586, pl. 15, fig. 57 (1947) ♀.
Type loc: Calamujuit, Lower California. Types: U.S.N.M.
Range: deserts of southern Arizona and southeastern California south into Mexico.

2. Acromyrmex (Moellerius) versicolor chisosensis (Wheeler)

Atta (M.) versicolor subsp. *chisosensis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 705 (1907) ♀.
Acromyrmex (M.) versicolor subsp. *chisosensis* Emery, in Wytsman Genera Insectorum, Fasc. 174, p. 351 (1922).

Type loc: Chisos Mountains, Texas. Types: A.M.N.H., M.C.Z.
Range: mountains of the Big Bend area in Texas. Although there are no records of this insect from Mexico it probably occurs in the Provinces of Chihuahua and Coahuila.

In his original description of *chisosensis* Wheeler used the reduced number of gastric tubercles as a distinguishing characteristic. I have found this distinction difficult to apply because the number of tubercles varies with the size of the worker. In the smaller workers of the typical *versicolor* the number of gastric tubercles is often greatly reduced. Hence, if this distinction is used, it must be remembered that it will hold only in the case of the largest workers.

Genus ATTA Fabricius

(Plate 42, figures 1–5)

In 1942 Gonçalves published a monograph of the genus Atta in which he proposed to divide the group into three subgenera. His three subgenera, which correspond exactly to the three groups of species set up by Emery in the *Genera Insectorum*, are based primarily on the characteristics of the genitalia of the male but Gonçalves was also able to draw distinctions from the worker caste which were based on the character of the thoracic spiracles and the occipital spines. I think it may be doubted that myrmecologists will accept Gonçalves proposal, for it seems that what he has described are specific differences rather than subgeneric ones. It is true that each of his subgenera contains at least two species but it has long been recognized that some of these species are very closely related. His subgenus Archeatta, for example, contains the species *mexicana, texana* and *insularis*, a group of forms which some authorities have regarded as components of a single species. On this basis, it is perfectly correct to regard the characteristics on which the subgenus Archeatta was erected as being the specific characteristics of the *insularis* complex. I believe that Senhor Gonçalves has overlooked the fact that the attine genera are more closely related than those of any other myrmicine tribe. There is scarcely a genus in this group which does not possess one or more species whose structure clearly indicates a relationship with the members of another genus. In the past this intergradation has been the cause of considerable confusion, since it gave rise to widely different proposals for the treatment of genera and subgenera in the Attini. The difficulty has been solved by the more or less tacit agreement to recognize genera among the Attini even when they are known to intergrade. Thus Acromyrmex, which is connected

to Atta through the species *landolti*, and Trachymyrmex, which grades into Cyphomyrmex through the transitional Mycetosoritis and into Atta through such species as *jamaicensis*, etc., have both been accorded generic status. If this is inconsistent with the practice found in other myrmicine tribes, it is at least expedient. For if one starts reducing these intergrading groups to subgenera, the logical outcome is a single genus, Atta, in which most of the present attine genera appear as subgenera. Something much like this occurred when Emery tried to expand Cyphomyrmex to include a number of closely related groups. But since the relationship of most attine genera to each other is already very similar to that which exists in the case of subgenera in other tribes, it follows that further subgeneric division within the Attini can only be justified for very compelling reasons. I do not regard the evidence on which Senhor Gonçalves bases his subgenera as of this character, hence I have treated the genus Atta as a single unit in this work.

As far as is known at present, only one member of the genus Atta, *A. texana*, occurs north of the Mexican border. The habits of this insect have been repeatedly, although often erroneously publicized. It has been studied by Buckley (1860), Lincecum (1867), Townsend (1870), McCook (1879) and Wheeler. The following account is largely taken from the excellent treatise which the latter author published in 1907. The nests of *texana* are constructed by preference in the vicinity of tree-bordered streams. The mature colony is very large and the nest may be of striking proportions. Above ground it consists of a series of shallow craters about fifteen inches in diameter and five or six inches high. These may be so closely packed together that they fuse to form an irregular mass of soil. The total area covered by the craters may be a hundred square feet or more. At the bottom of each crater is a single, irregular opening which leads through an unbranched passage to one of the nest chambers. These are usually built in a layer of sand. To reach such a sandy layer, the ants will sometimes drive the passages through twelve or fifteen feet of overlying soil. The chambers themselves vary considerably in size. They may, at times, be as much as three feet long and McCook ('79) reported one very large nest chamber which he claimed was the size of a flour-barrel. As a rule, however, the size of the chambers averages less. They are usually about one foot in length and less than a foot high. It is in these chambers that the fungus garden is prepared and the fungus grown. The substrate on which the fungus is cultivated consists of triturated leaves and other bits of vegetable material. In the larger chambers the garden is arranged in the form of a loose, flocculent mass which lies on the floor. In the smaller chambers the garden is frequently suspended on rootlets which dangle from the roof. In

either case it soon becomes covered with a dense mass of mycelial filaments. On this mycelium are produced globular swellings which Wheeler has called bromatia. These and the filaments themselves constitute the food of the leaf-cutters. The arrangement of the fungus garden and its subsequent care after the mycelium has become established is mainly the work of the smallest caste of workers. They not only tend the fungus garden but also look after the larvae, which are usually placed in the interstices of the garden where they are surrounded by the mycelial filaments on which they feed. The cutting and transportation of the leaf fragments is primarily accomplished by the media workers, although minor workers sometimes engage in this phase of activity. After the leaf fragments have been brought into the nest they are softened by chewing and the addition of salivary juices. When sufficiently macerated they are built into the garden. The major workers appear to take very little part in the fungus growing. Indeed, their presence in the fungus garden seems to be detrimental, since their large size and weight breaks down the delicate substrate. The majors function in the defence of the colony and as a rule do not appear on the surface unless the nest is disturbed. Wheeler has shown that *texana* is very sensitive to changes in temperature and humidity. Their daytime foraging is confined to the cooler months and with the onset of hot summer weather they remain in the nest until dark. He has also pointed out that the size of the ventilating passages is carefully regulated to insure the proper humidity for the fungus gardens. In very dry weather the apertures may be entirely closed.

1. Atta texana (Buckley)

Myrmica texana Buckley, Proc. Acad. Nat. Sci. Phila., p. 233 (1860) ♀ ♀ ♂.

Atta texana Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 23, p. 700, pl. 49, figs. 11–14 (1907) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 591, pl. 15, fig. 58 (1947) ♀.

Oecodoma texana Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 374 (1867) ♀ ♀ ♂.

Atta fervens Townsend, Ann. Ent. & Bot., Vol. 2, p. 224, figs. 202, 203 (1870) ♀ ♀.

Type loc: Texas. Types: none known to exist.

Range: the range of *texana* is largely confined to south central Texas. A line drawn from Houston through Austin and San Antonio and thence south to Brownsville would include the majority of the records. This insect undoubtedly occurs in northeastern Mexico, although there is too little data at present to determine the southern limit of the range. It seems, however, that unlike several other species which range northward from Mexico and into the eastern Gulf states, *texana* does not occur east of Texas, although there are areas in Louisiana and Mississippi which appear suitable for it.

Subfamily DOLICHODERINAE

The representatives of the Subfamily Dolichoderinae which live in America north of Mexico are a rather uniform group both in habits and structure. All six of the genera which occur within our borders exhibit a very generalized type of behavior. They prefer to nest in soil but will utilize other nest sites on occasion. They show little evidence of dietary specialization, for all will feed on honey-dew or other insects or practically any food that is readily available. This latter characteristic has made some of the species serious pests, for they will often invade homes in search of food. It is interesting to note that while one genus, Dorymyrmex, is rather notably xerophilous, it has retained the same generalized feeding habits that mark the rest of the group.

The structure of several of the genera is disconcertingly similar. It seems impossible to secure clear-cut external characters to separate Iridomyrmex, Forelius and Tapinoma. In these genera, as elsewhere in the subfamily, the best generic criteria are internal. The structure of the gizzard can be used to supplement the rather unsatisfactory external differences but, since the examination of this organ involves microtechniques which are scarcely feasible in the field, no attempt has been made to give these internal distinctions here. A full exposition of them may be found in the key which Emery published in the *Genera Insectorum* in 1912 (Fasc. 137). It should be noted that several of the distinctions employed in the generic key below are applicable only to our species and will not apply to the genus as a whole. Where there is so much difficulty in arriving at satisfactory generic distinctions it seems best to make certainty of recognition the primary consideration.

Key to the Genera in the Subfamily Dolichoderinae

1. Declivious face of the epinotum very strongly concave; integument stiff and brittle; epinotum and often much of the remainder of the thorax, heavily sculptured ..... *Dolichoderus*
   Declivious face of the epinotum straight or nearly so; integument thin and flexible; sculpture everywhere fine 2
2. The epinotum with a prominent, sharp, tooth-like protuberance projecting vertically at the junction of the basal and declivious faces; third segment of the maxillary palp very long, as long or longer than the three succeeding segments taken together ..... *Dorymyrmex*
   The junction between the basal and declivious faces of the epinotum unarmed, rounded or angular; third segment of the maxillary palp not unusually long and notably shorter than the three succeeding segments taken together 3

3. Dorsum of the thorax without an impression at the mesoepinotal suture; worker caste moderately polymorphic; female 10 mm. or more in length ..... *Liometopum*
   Dorsum of the thorax at least with a slight impression at the mesoepinotal suture; worker caste monomorphic; female 6 mm. or less in length..... 4
4. Scale of the petiole vestigial..... *Tapinoma*
   Scale of the petiole present although often small and difficult to see.... 5
5. Erect body hairs long and sparse, absent on the scapes and tibia; scale of the petiole long enough for the tip to project beyond the overhanging anterior face of the gaster..... *Iridomyrmex*
   Erect body hairs short and numerous, present on scapes and tibiae; scale of the petiole small, short and largely concealed by the overhanging anterior face of the gaster..... *Forelius*

Genus DOLICHODERUS Lund

Subgenus HYPOCLINEA Mayr

(Plate 43, figures 1–4)

The representatives of Dolichoderus which occur in the United States and Canada all belong to the subgenus Hypoclinea, a group which occurs in the north temperate portion of both hemispheres. Although Hypoclinea was monographed by Mayr in 1866 and by Wheeler in 1905, there are still points in the taxonomy of our species which are not satisfactory. The writer finds himself at odds with so many of the statements that Wheeler made in 1905 that it seems worth while to review the opinions which he advanced at that time. Wheeler constructed a phylogenetic tree for our representatives of Hypoclinea by using sculpture as the indicator of evolutionary advance. According to this view the ancestral form of Hypoclinea was a heavily sculptured insect, hence the weaker the sculpture the more advanced its possessor was supposed to be. On this basis *plagiatus* became the prototype from which our other species have been derived. Wheeler's view that the species are closely related agreed with Mayr's earlier pronouncement. But Wheeler was unwilling to accept Mayr's observation that the species are not interconnected. Wheeler's phylogenetic plan demanded interrelationships and he attempted to supply them. He made *pustulatus* a subspecies of *plagiatus* and treated both *pustulatus* and the subspecies *davisi* as intermediate conditions between *mariae* and some ancestral form similar to *plagiatus*. Some years later Wheeler took a similar view of the variety *blatchleyi*. There is no objection to phylogenetic speculation but it is not un-

reasonable to ask that it subserve facts and not supersede them. It is my opinion that Wheeler overestimated the importance of his phyletic scheme and allowed it to exercise an unjustifiable effect on his taxonomy. It is easy to demonstrate that *pustulatus* cannot be considered a subspecies of *plagiatus* on any grounds. It can be shown that neither *davisi* nor *blatchleyi* are transitional between the species which they are supposed to link. It is plain that Wheeler minimized the specific differences which mark the representatives of Hypoclinea and strove to give the impression that it is an intergrading group. The writer agrees with Mayr that it is not, and can see nothing to be gained by forcing the species into a phyletic system to which they seem very ill-adapted. I further see no justification for Wheeler's recognition of the color phases which he set up as varieties. It may be noted that in every case the variant or the 'typical' form with which it was compared was represented by inadequate material. Thus *gagates* (or, as it was later called, *aterrima*) was established because of a wholly inconsequential color difference which supposedly distinguished it from the *one* specimen in Wheeler's collection which he regarded as the 'typical' *taschenbergi*. The subspecies *davisi* was described from seven specimens, *inornatus* and *blatchleyi* from eight each and *beutenmuelleri* from eleven, all strays. None of these variants give the slightest indication that they possess any distinguishing distributional features and most of them are so inconstant that the definitive distinctions apply well only in the case of selected individuals. For the above reasons I have treated all of Wheeler's variants as synonyms of their respective species.

Wheeler's observations on the habits of these insects are far more satisfactory. He was able to show that both *mariae* and *taschenbergi* prefer to nest in pure sand. The nests are usually constructed beneath tufts of grass or small bushes and consist of a single, large chamber a foot or more deep and several inches across. The roots of the plant ramify through this chamber and serve not only to keep its walls from collapsing but also as a sort of a scaffolding on which the brood is placed. In some nests the plant is partially buried by a low mound of collected detritus but there seems to be no fixity in this habit for as often as not the nest is unthatched. Both *mariae* and *taschenbergi* produce large colonies consisting of thousands of individuals. Both species forage in files and are active in collecting the sugary secretions of coccids and aphids. They will also eat other insects. Wheeler's account has been repeatedly confirmed by subsequent observers. The colonies of *pustulatus* and *plagiatus* are notably smaller than those of the two preceding species. The nests of *pustulatus* have been described by the Wessons (1940) as consisting of a

hard, thin, firm carton shell built above ground and about the blades of a tuft of grass. The entrance of the nest consists of a small carton tube about three-quarters of an inch long which projects from the main shell 'like a spout on a tea kettle'. The Wessons described other nests of *plagiatus* which seem to be nothing more than irregular chambers under piles of detritus. It may be assumed that such nests are temporary shelters for all the species of Hypoclinea are prone to move to new nest sites. There is little agreement concerning the nests of *plagiatus*. Wheeler (1905) and Cole (1940) have both taken *plagiatus* from small, obscure nests in the soil. These seem to consist of little more than a few short passages leading away from the single nest entrance. The Wessons have taken nests of *plagiatus* in hollow stems and in curled up leaves.

All of our species of Hypoclinea possess repugnatorial glands which produce a volatile secretion with an odor which has been described as 'smoky or pungent'. In this respect they differ from our other dolichoderine genera in which the odor produced is generally like that of butyric acid.

Key to the species of Hypoclinea

1. Cephalic foveolae coarse, deep and very close-set so that the surface between them forms a reticulo-rugose pattern; the antennal scapes with numerous short, erect hairs on their anterior surfaces ..... *plagiatus*
   Cephalic foveolae shallow, often replaced on the front and vertex by small punctures, the foveolae well separated with the surface between them delicately shagreened and never forming a reticulo-rugose pattern; antennal scapes usually without erect hairs, rarely one or two present 2
2. Epinotum, seen from above, subquadrate, very slightly or not at all longer than broad; color uniform brownish black or piceous ..... *taschenbergi*
   Epinotum, seen from above, very distinctly longer than broad; color rarely as above, often bicolored or at least with the thorax lighter than the gaster 3
3. Dorsum of the epinotum and mesonotum with coarse, deep, close-set foveolae forming a reticulo-rugose pattern; the mesopleurae very smooth and shining ..... *pustulatus*
   Dorsum of the epinotum and mesonotum granulose or densely shagreened; foveolae, when present, shallow and obscure; the mesopleurae in large part or entirely shagreened, subopaque or dull ..... *mariae*

1. Dolichoderus (Hypoclinea) mariae Forel

D. mariae Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 20, p. 349 (1884) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 436 (1886) ♀ ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 306, fig. A (1905) ♀ ♀ ♂.

D. mariae subsp. *davisi* Wheeler, Ibid., p. 308 (1905) ♀.
D. mariae var. *blatchleyi* Wheeler, Proc. Ind. Acad. Sci., Vol. 37, p. 462 (1917) ♀
Type loc: Vineland, New Jersey. Types: none in this country.
Range: southern New England south to the Gulf States and west as far as Illinois and Oklahoma. The insect is very sporadic over its entire range.

The variety *blatchleyi* appears to be no more than a very minor color variation of *mariae* and the writer can see no basis whatever for Wheeler's statement that it is transitional between *mariae* and *pustulatus*. The thoracic sculpture of *mariae* is wholly different from that of *pustulatus* (see key) and in addition the scapes of *mariae* are distinctly longer than those of *pustulatus*. Wheeler's variety *blatchleyi* agrees in both respects with *mariae*. It is 'transitional' to *pustulatus* only insofar as its color is a trifle darker than that usually encountered in specimens of *mariae*. In my opinion *blatchleyi* is an insignificant color phase of *mariae* which should never have been named. The subspecies *davisi* is scarcely more distinct, although there are circumstances which necessitate a more careful consideration of this form. From Wheeler's description of *davisi* it would appear that the insect is notably different from the typical *mariae*. Indeed, if these differences were as described, it would be possible to regard *davisi* as a separate species. Unfortunately, this is not the case. There is no significant difference in the size of the two insects, for the workers of *davisi* are fully as large as the small workers of *mariae* and since *davisi* is known from very limited material, the absence of larger workers is no proof that they do not exist. The structure of the epinotum and the petiolar scale in *davisi* is not different from that of *mariae* and the distinctions noted by Wheeler in 1905 appear to be contrary to fact. Nor is *davisi* distinguished by a unique hair pattern. Since Wheeler considered the typical *mariae* as being devoid of erect hairs on the upper surface of the body, he was able to use the presence of erect hairs in *davisi* as a distinguishing feature. The typical *mariae* is not devoid of erect hairs on the upper surface of the body. There are usually a few erect hairs present on the front and vertex in *mariae* and occasionally one or two on the pronotum as well. It may be admitted that the erect hairs in *davisi* are a little more abundant than is usually the case with *mariae* but the difference is by no means as great as would be inferred from Wheeler's description. We have in *davisi* an insect in which the color is a little duller, the cephalic sculpture a trifle heavier and the erect hairs slightly more numerous than is ordinarily the case with *mariae*. Even though these differences are less striking than Wheeler supposed, it might be possible to retain *davisi* as a subspecies if it had any distinguishing peculiarity of range. Unfortunately, it does not. So far, all the material of *davisi* has come

from the New Jersey pine barrens. There it occurs with *mariae* for, although the latter insect has a much more extensive range, it is abundant only in the pine barren regions. Since *davisi* is clearly not a geographical race of *mariae* and since the differences which it shows are certainly not of sufficient magnitude to justify specific status, it has been treated as a synonym of *mariae* in the present work. It may be added that *davisi* has the long antennal scapes and the characteristic thoracic sculpture of *mariae* and has nothing in common with *plagiatus* or *pustulatus*. I can see no reason why Wheeler should have regarded *davisi* as a 'hybrid form' which combined the characters of *mariae* and *plagiatus*.

2. Dolichoderus (Hypoclinea) plagiatus (Mayr)

Hypoclinea plagiatus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 960 (1870) ♀.
D. plagiatus Mayr, Ibid., Vol. 36, p. 436 (1886) ♀ ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 310, fig. c (1905) ♀ ♀ ♂.
D. borealis Provancher, Natur. Canad., Vol. 5, p. 408 (1888) ♀.
D. plagiatus var. *inornatus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 313 (1905) ♀.
Type loc: Illinois. Types: none in this country.
Range: southern Ontario and New Brunswick south to Georgia and Tennessee and west to North Dakota. Most of the southern records for *plagiatus* come from stations in the Appalachian Highlands.

The color variety which Wheeler described as *inornatus* is not of sufficient constancy to justify recognition. Both the thorax and the gaster of *plagiatus* vary considerably in the extent of their infuscation, hence it is usually possible to find specimens referable to *inornatus* in any long nest series of the typical form.

3. Dolichoderus (Hypoclinea) pustulatus Mayr

D. pustulatus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 436 (1886) ♀ ♀.
D. plagiatus subsp. *pustulatus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 313 (1905) ♀ ♀.
D. plagiatus var. *beutenmuelleri* Wheeler, Ibid., Vol. 20, p. 304 (1904) ♀; Wheeler, Ibid., Vol. 21, p. 313 (1905) ♀.
Type loc: New Jersey (by present restriction). Types: none in this country.
Range: southern Nova Scotia south to Florida and southwestward to Texas. In the northern United States the western limit of the range appears to lie in Illinois but in the south it extends considerably further west. Dr. Smith has recorded *pustulatus* from Norman, Oklahoma and I have specimens taken by Dr. P. J. Darlington in Brownsville, Texas.

Wheeler's variety *beutenmuelleri* is quite indefensible. As Mayr noted in his original description of *pustulatus*, the gastric spotting of this species is very variable. This is also true of the coloration of the thorax which is sometimes just as dark as the head and gaster. As has been noted on an earlier page, it is impossible to treat *pustulatus* as a subspecies of *plagiatus*. The writer finds it impossible to follow Wheeler's reasoning in this matter. He was certainly aware of the notable difference in the sculpture of the two insects, for he used this difference as the first split in his key. But despite the fact that the sculpture of *pustulatus* indicated a closer relationship with *mariae* and *taschenbergi* than with *plagiatus*, Wheeler allied it to the latter form. It is difficult to avoid the impression that the main reason why he did so was to provide a connection with his hypothetical '*plagiatus*-like ancestor'. The sculpture of *pustulatus* lacks entirely the reticulo-rugose character which marks *plagiatus*, except on the epinotum and to a lesser extent on the mesonotum. The head and pronotum are covered with shallow, rather widely spaced foveolae between which the surface is smooth with only a delicate shagreened sculpture present. The promesonotum is more strongly convex in *pustulatus*, with the promesonotal suture very much more distinct. Erect hairs are rarely met with on the scapes of *pustulatus*, while they are regularly present in considerable abundance on the scapes of *plagiatus*. Finally, since the ranges of the two species are largely coincidental over most of the eastern United States, it would be out of the question to consider *pustulatus* as a subspecies from a distributional standpoint if for no other reason.

4. Dolichoderus (Hypoclinea) taschenbergi (Mayr)

Hypoclinea taschenbergi Mayr, Sitz. Akad. Wiss. Wien, Vol. 53, p. 498 (1866) ♀ ; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 958 (1870).

D. taschenbergi Mayr, Ibid., Vol. 36, p. 436 (1886) ♀ ; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 309, fig. B (1905) ♀ ; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 590, pl. 16, fig. 60 (1947) ♀.

D. taschenbergi var. *gagates* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 310 (1905) ♀ (*nec* Emery).

D. taschenbergi var. *aterrima* Wheeler, Ibid., Vol. 34, p. 417 (1915) (*nomen nov.*).

Type loc: North America. Types: none in this country.

The original description of *taschenbergi* did not cite Louisiana as the type locality although the types may have been taken there.

Range: Nova Scotia west to Manitoba and south to the Gulf States. The insect appears to be rare in the southern half of its range.

The characters on which Wheeler based the variety *gagates* (= *aterrima*) are so little different from those described for the typical form

that it does not seem to represent even a color phase and one wonders why Wheeler felt it necessary to give a name to what is so clearly a synonym of *taschenbergi*.

Genus LIOMETOPUM Mayr

(Plate 44, figures 1–4)

With the recognition of the specific status of *occidentale* by Wheeler in 1917 this insect was given a taxonomic stability which it had conspicuously lacked during the previous quarter of a century. It would seem, however, that Wheeler was at that time still unaware of the specific characteristics of the worker of *occidentale*. For Wheeler never realized that *luctuosum* is much more closely related to *occidentale* than to *apiculatum*. As long as *luctuosum* is to be considered as a subspecies it must be assigned to *occidentale*, not only because of its closely related structure but also because its distribution indicates that it cannot be considered a geographical race of *apiculatum*. This point has been explained in more detail on a subsequent page. It seems well to mention here certain taxonomic difficulties which have to do with *apiculatum*.

Wheeler's 1905 description of that species was a composite one. It was based upon a female from Mexico which Mayr had sent him, a female and a male from Arizona and a series of workers taken on the volcano of Colima in southern Mexico. It follows, therefore, that of the three castes described only the female can be said to be based upon authentic material. I mention this matter because certain features embodied in Wheeler's figures and descriptions accord very poorly with most of the material which he assigned to *apiculatum*. The petiolar scale of the worker was figured and described as having a long, slender spine arising from the middle of the crest. The petiolar scale of the female was shown as distinctly lyrate with the central notch bounded at either side by a tooth-like projection which angles outward from the notch. I do not contend that such conditions never occur in specimens coming from the United States but I have never encountered them. In the material from the western states the crest of the petiole in the worker is produced upward in a sharp angle but this angle is not surmounted by a spine. The scale of the female has a strong notch in the middle of the crest but it is certainly not lyrate and the crest at either side of the notch is stout, not tooth-like and not turned outward. This leads one to suspect that the specimens of *apiculatum* coming from the United States are subspecifically different from those which occur in southern Mexico. But since we know that

specimens of *apiculatum* from northern Mexico are like those from the western states and since there is no way of proving exactly what the worker of Mayr's *apiculatum* is like without recourse to type specimens, it seems best to leave matters as they are until this difficulty can be resolved by a further examination of type material.

The ants belonging to Liometopum are more aggressive than those of most of our dolichoderine genera. Both *apiculatum* and *occidentale* often form large colonies and are very pugnacious insects. They forage in files and attack fiercely if they are disturbed. They possess a secretion with a powerful and disagreeable odor like that of butyric acid and they spray this on intruders. The nests are usually built under stones or in hollow trees. The nest chambers are sometimes subdivided by a ramifying mass of paper-like material. The insects manufacture this by mixing bits of soil and vegetable detritus with a secretion which hardens and gives solidity to the mass. Wheeler has shown (1905) that our species of Liometopum will tend aphids and coccids. The European species *microcephalum* is said to eat aphids but not to use their secretions. Our species will feed upon any insects they can capture. In Emery's opinion the females of Liometopum are losing the power of flight (1891). Those of *apiculatum* at least, are certainly exceptionally gross and clumsy insects. Our three forms can be separated as follows:

Key to the species of Liometopum

1. The antennal scapes of the largest workers surpassing the occipital corners by an amount at least twice as great as the maximum thickness of the scape; the anterior edge of the mesonotum not raised above the adjacent edge of the pronotum; erect hairs on the gastric dorsum very uneven in length with at least some of them about as long as those on the pronotum *apiculatum*

   The antennal scapes of the largest workers surpassing the occipital corners by an amount which does not exceed the maximum thickness of the scape; the anterior edge of the mesonotum distinctly raised above the adjacent edge of the pronotum; erect hairs on the gastric dorsum, when present, short and of approximately equal length 2

2. Erect hairs on the dorsum of the gaster abundant, those on the thorax present over most of the upper surface; the body only moderately shining; thorax in part or entirely yellow . . . . . *occidentale*

   Erect hairs on the dorsum of the gaster very sparse or absent, those on the thorax largely confined to the pronotum; the body rather strongly shining; color always uniform brown . . . . . *occidentale* subsp. *luctuosum*

1. Liometopum apiculatum Mayr

L. apiculatum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 961(1870) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 331 (1895) ♀; Viereck, Trans. Amer. Ent. Soc., Vol. 29, p. 71 (1903) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 322, fig. a–c (1905) ♀ ♀ ♂.

Type loc: Mexico. Types: none in this country.

Range: Colorado through New Mexico, Arizona and western Texas into Mexico.

This species generally nests in foot-hill areas at elevations between 5000 and 7000 feet. Wheeler was of the opinion that it is always associated with live-oak trees and in general this seems to be true. But in the northern part of its range it sometimes occurs in stations where no live oak trees are present. It seems worth noting that the female of *apiculatum*, labelled as a type in the collection of the M.C.Z., is the specimen which Mayr sent to Wheeler. It is not a type, since the type female of *apiculatum* was first described by Emery.

2. Liometopum occidentale Emery

L. microcephalum var. *occidentale* Emery, Zool. Jahrb. Syst., Vol. 8, p. 330 (1895) ♀ ♂.

L. apiculatum var. *occidentale* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 324 (1905) ♀.

L. occidentale Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, No. 8, p. 522 (1917) ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 590, pl. 16, fig. 61 (1947) ♀.

Type loc: San Jacinto, California. Types: none in this country. A part of the type series is present in the M.C.Z.

Range: northern Oregon through California into Mexico.

This species nests at lower elevations than does its subspecies *luctuosum*. In California it appears to be most abundant at levels between 1000 and 4000 feet and is only rarely taken at higher elevations.

3. Liometopum occidentale luctuosum Wheeler

L. apiculatum subsp. *luctuosum* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 325 (1905) ♀.

Type loc: Cheyenne Canyon, Colorado Springs, Colorado. Types: M.C.Z.

Range: southern Wyoming to New Mexico and Arizona and the mountains of California. The insect appears to be rare in Utah and Nevada although one would expect it to be abundant in the mountains of these states.

The short antennal scapes and the elevated mesonotum of *luctuosum* relate it to *occidentale* rather than to *apiculatum*. The erect hairs on the gaster, when present, are also like those of *occidentale*. It is of interest to note in this connection that while the preference of *luctuosum* for nests at higher levels (4000–7000 feet) keeps its range largely separate from that of *occidentale*, the insect occurs in the same stations as *apiculatum* at the eastern end of its range. For this reason alone it would be impossible to consider *luctuosum* as a subspecies of *apiculatum*.

Genus IRIDOMYRMEX Mayr

(Plate 45, figures 1–4)

Some of the species belonging to this genus present a problem to anyone dealing with our native ant fauna for there seems to be no altogether satisfactory method for handling several of the imported forms. There is no question, of course, in the case of the notorious Argentine ant, *I. humilis*. Most people living on the Gulf Coast or in southern California can testify that this insect has completely adapted itself to life in the United States and will have to be regarded as a permanent, if unpleasant, addition to our ant fauna. This is not so clear for other imported species which have turned up in greenhouses in various parts of the country. One of these, *I. iniquus* subsp. *nigellus*, has received particular attention. For many years it was established in one of the greenhouses at the Bussey Institution, where Dr. Wheeler repeatedly observed it. This insect is now treated as a member of our ant fauna but the propriety of such treatment may be doubted. All records for *nigellus* have come from greenhouses or dwellings and there is nothing to indicate that this Costa Rican subspecies can endure the rigors of our winter climate even in the southern states. It might possibly do so in extreme southern Florida but, oddly enough, it does not appear to occur there. It seems to the writer that there is no more justification for treating *nigellus* as a member of our ant fauna than there would be for including the giraffes and kangaroos of our zoological parks in a list of North American mammals. On the other hand to omit *nigellus* from a comprehensive treatment of our ants would certainly lead to confusion. I have, therefore included this alien insect with our native ants.

The habits of all the species of Iridomyrmex which occur in the United States are rather uniform. They are very active insects, despite their rather small size, and they prefer to forage in files. Although the ants in the files are close together they evidently follow a scent

path, for I have repeatedly observed that in the case of *I. humilis* the file can be thrown into great confusion by simply drawing a finger across the path. A 'traffic jam' immediately develops at either side of the patch of foreign scent and this persists until a few bold spirits have ventured across the finger mark and reëstablished the proper scent trail. All our species nest in soil, although *humilis* will frequently move indoors during the winter months. The insects collect honeydew from various sources. They are also entomophagous.

Key to the species of Iridomyrmex

1. The antennal scape in repose surpassing the occipital margin by an amount equal to or somewhat greater than the length of the first funicular joint; the middle of the occipital margin flat or slightly convex.....2
   The antennal scape in repose surpassing the occipital margin by an amount approximately equal to one-half the length of the first funicular joint; the middle of the occipital margin broadly but feebly impressed.....3
2. The greater part of the dorsum of the mesonotum bearing a flattened, irregular impression; mesoepinotal suture deeply impressed, the epinotum sharply set off from the rest of the thorax; appressed pubescence very dilute, the surface strongly shining.....*iniquus* subsp. *nigellus*
   Dorsum of the mesonotum unimpressed; mesoepinotal suture only moderately impressed, with the epinotum not notably set off from the rest of the thorax; appressed pubescence abundant, the surface feebly shining..*humilis*
3. Head and thorax with abundant, appressed, silvery pubescence which is dense enough to partially obscure the delicately shagreened surface beneath; head and thorax usually sordid brown.....*pruinosum*
   Appressed pubescence on the head and thorax more dilute, revealing the rather shining surface beneath; color highly variable, deep brown to pale yellow.....*pruinosum* subsp. *analis*

1. Iridomyrmex humilis (Mayr)

(Introduced)

Hypoclinea humilis Mayr, Ann. Soc. Nat. Modena, Vol. 3, p. 164 (1868) ♀.

Hypoclinea (*Iridomyrmex*) *humilis* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 959 (1870) ♀.

Iridomyrmex humilis Forel, Ibid., Vol. 58, p. 395 (1908) ♂; Newell, Jour. Econ. Ent., Vol. 1, p. 28 (1908) ♀ ♀ ♂; Newell, Ibid., Vol. 2, p. 182, fig. 4 a–c (1909) ♀ ♀ ♂; Emery in Wytsman *Genera Insectorum* Fasc. 137, pl. 1, fig. 14, 14b (1912); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 590, pl. 16, fig. 62 (1947) ♀.

Type loc: Buenos Aires, Argentina. Types: none in this country.

Range: (in the United States) South Carolina west to Texas and south to Florida. California, particularly the southern half of the state.

A great deal of effort has been expended on the control of this ant, since it is a serious pest in many southern areas. While *humilis* readily feeds upon sugary foods and can be held in check by the use of poisoned baits, such methods are usually not continued long enough to give a permanent relief from this pest. In the opinion of the writer there is evidence that in certain areas, formerly overrun by *humilis*, this insect is reaching a balance with our native ants. Thus in Mobile, Alabama, where the infestation was exceptionally heavy about twenty-five years ago, *humilis* at first dominated the area. Except for *Pogonomyrmex badius* and a species of Monomorium (probably *viridum peninsulatum*) the native ants were largely eliminated in the infested area. Later, however, the native species began infiltrating back into the infested area. By 1932 a considerable number of native species had reëstablished themselves. This might have led to a balanced condition. But soon after there was a notable increase in the population of *Solenopsis saevissima richteri*, another importation from Argentina. This species is now as much of a pest as *humilis* formerly was.

2. Iridomyrmex iniquus nigellus Emery

(Introduced)

I. iniquus var. *nigella* Emery, Bull. Soc. Ent. Ital., Vol. 22, p. 56 (1890) ♀.
Type loc: Costa Rica. Types: none in this country.
Range: (in the United States) greenhouses in various parts of the country, particularly in the northeastern states.

3. Iridomyrmex pruinosum (Roger)

Tapinoma pruinosum Roger, Berl. Ent. Zeitschr., Vol. 7, p. 16 (1863) ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 333 (1895) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 389 (1905).
Iridomyrmex pruinosus Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 54, No. 17, p. 497 (1913) ♀ ♀.
Tapinoma boreale Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 434 (1886) ♀ (*nec* Roger, *nec* Mayr 1866).
Type loc: Cuba. Types: none in this country.
Range: (in the United States) Florida and the eastern Gulf States west to Texas and New Mexico and North to Ohio and southern Wisconsin.

There has been much confusion between this insect and its western subspecies *analis*. It is not possible to separate the two on the basis of color alone. The eastern *pruinosum* appears to be considerably more stable in coloration than *analis*, for the head and thorax of the

typical *pruinosum* are usually sordid brown. But both races may show the bicolored gaster which has been taken by many myrmecologists as the distinguishing mark of *analis*. For this reason many of the eastern records attributed to *analis* probably belong to *pruinosum*. The size of *pruinosum* is slightly greater than that of *analis* and in *pruinosum* the head and thorax are distinctly more pubescent. The two races intergrade broadly in western Texas and New Mexico. Material coming from this region is particularly difficult to handle, since it is often impossible to assign it to either race.

4. Iridomyrmex pruinosum analis (E. André)

Tapinoma anale E. André, Rev. Entomol., p. 148 (1893) ♀.
T. pruinosum var. *anale* Emery, Zool. Jahrb. Syst., Vol. 8, p. 333 (1895).
I. pruinosum var. *testaceus* Cole, Ent. News., Vol. 47, No. 5, p. 121 (1936) ♀.
Type loc: Terraras, Chihuahua, Mexico. Types: none in this country.
Range: California east to Texas, Oklahoma and Kansas. The northern limit of the range appears to lie in southern Idaho.

There is little justification for the naming of the variety *testaceus*. The characteristics which supposedly distinguish *testaceus* are mainly those of color. It seems evident that when Dr. Cole described *testaceus*, he was unaware that *analis* is highly variable in color over its entire range. There are some specimens which are fully as dark as the eastern *pruinosum* and others which are even lighter than the types of *testaceus*. Since I have been unable to see that these color fluctuations have the slightest distributional significance, I believe that *testaceus* must be treated as a synonym of *analis*.

Genus Forelius Emery

(Plate 46, figures 1–4)

The genus Forelius is a small New World group which is represented in the United States by a single species, *F. foetida*. There have been a number of curious inconsistencies concerning the name of this species. For many years it was known as *maccooki*. Oddly enough, Forel, who first used this name in 1878, did so without any accompanying description. Thus the first person who published a description of *maccooki* was McCook himself. Nevertheless the name is generally credited to Forel. In subsequent years the insect was described several times under the name *maccooki* but in 1902 Wheeler

published very strong evidence to show that this name had been applied to the insect which Buckley had described in 1866 as *Formica foetida*. It is probable that Buckley's description of *foetida* would have remained with those of his many unrecognizable species had it not been for the fact that he included in it a remarkably complete and accurate summary of the habits of the insect. He noted that the ants are very active, that they forage in files and often ascend trees, that they frequently construct craters at the nest entrance, that they have a disagreeable odor of rotten cocoanuts, which they emit when disturbed, and that they usually have multiple queens in the nest. These observations had been of little use to the European specialists who had previously considered the probable nature of *foetida*. Their approach had been mainly from the morphological standpoint, which was unavoidable in view of their lack of field knowledge of our ants. In Wheeler's case the situation was different. His profound acquaintance with the habits of the ants of Texas enabled him to recognize that Buckley's *foetida* was the same insect that, since 1878, had been passing as *maccooki*. He therefore proposed the needed synonymy and shifted *foetida* to the genus Forelius. What happened thereafter is, to the writer at least, thoroughly inexplicable. Instead of sticking to his synonymy Wheeler continued to use either name indiscriminately, and this singular and wholly unjustifiable practice appears to have been generally adopted. It even extended to the usually cautious Emery, who, when it was necessary to designate the genotype of Forelius in the *Genera Insectorum*, cited both names with *maccooki* taking preference in the matter of position. Since in the body of that work he treated *foetida* as a valid species and made no question of Wheeler's synonymy of *maccooki*, his extraordinary citation in the case of the genotype constitutes one more incomprehensible feature of this curious tangle. As things stand at present, *maccooki* is usually cited as the genotype of Forelius and this practice has certain advantages for Forel's types are presumably still in existence and in any case there has never been the slightest question as to the insect he described as *maccooki*. But while one may laud this commendable caution in regard to Buckley's species, it would seem that in this case conservatism is defeating itself. It has now been almost half a century since Wheeler proposed to make *maccooki* a synonym of *foetida*. If this synonymy is unacceptable there has surely been ample time to prove it so. If this cannot be done, as seems to be the case, it is more than time that we stop using Forel's name *maccooki*. Its continuance is certain to add further confusion to a situation for which there is neither logical explanation nor legal justification.

The genus Forelius is remarkable in another respect, for it is one of the few genera whose certain definition rests upon an internal character. The sepals of the proventriculus are reflected, as is the case with most of the dolichoderine genera, but only the tips of these reflected sepals cover the bulb of the proventriculus. In this particular Forelius shows a distinct difference from Iridomyrmex (which it otherwise strongly resembles), since in the latter genus the reflected sepals are broadly appressed over the surface of the proventricular bulb. It may be taken as axiomatic that such characters have little appeal for most taxonomists. The technique of exposing the proventriculus is difficult and the parts must be cleared before they can be properly studied. There is, in addition, the distasteful fact that the specimens so treated must be mutilated in the process. It is, therefore, a matter of gratification that for practical purposes *foetida* can be recognized without resort to the structure of the proventriculus. In *foetida* there are a number of short, erect, golden hairs which occur on the upper surface of the head, the dorsum of the thorax and to a less extent on the dorsum of the gaster. Similar erect hairs are present on the antennal scapes and the tibiae. Since none of the species of Iridomyrmex which occur in the United States have the above hair pattern, it follows that this permits an easy separation for *foetida*. It should be borne in mind, however, that from the more general point of view the two genera must be separated on the structure of the proventriculus.

1. Forelius foetida (Buckley)

Formica foetida Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 167 (1866) ☿ ♀.

Forelius foetida Wheeler, Trans. Texas Acad. Sci., Vol. 4, part 2, p. 24 (1902); Emery in Wytsman *Gen. Insect.* Fasc. 137, p. 35, pl. 1, fig. 18 (1912).

Iridomyrmex maccooki Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 15, p. 382 (1878) (no description); McCook in Comstock, Rep. Cotton Insects, p. 187 (1879) ☿; Forel, Ann. Soc. Ent. Belg., Vol. 30, C. R., p. 39 (1886) ☿; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 432 (1886) ♀ ♂.

Forelius maccooki Emery, Zeitschr. Wiss. Zool., Vol. 46, p. 389 (1888); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 595, pl. 17, fig. 63 (1947) ☿.

Type loc: central Texas. Types: none known to exist.

Range: central Texas west to southern California and south into Mexico. The insect also occurs in Oklahoma and there are a few records from Kansas. The majority of the records are, however, from Texas, which appears to be the only part of the country where the insect is really abundant.

Genus DORYMYRMEX Forel

(Plate 47, figures 1–4)

The majority of the species belonging to the genus Dorymyrmex occur in South America, and the group is represented in the United States only by forms belonging to the species *pyramicus*. This insect has an extraordinary range. It occurs as far north as North Dakota and ranges southward as far as Argentina. The typical form is said to occur throughout the entire range. While this may be doubted, I shall presently attempt to show that it is best to allow this view to stand unquestioned for the present. In all parts of its range *pyramicus* has produced variants. Most of these are marked by differences of color and in certain cases the contrast is very striking. It is not surprising that these variants were soon noted and given varietal and subspecific names. This practice has resulted in certain difficulties. Because it is easier to deal with color than with structure, there has been little attempt to reinforce the color distinctions with more reliable features based upon structure. The lack of any other separatory characters has caused considerable confusion as to the limits of the several variants. It will be clear to anyone who has examined the observations published on *pyramicus* and its variants in the United States, that there is little agreement concerning the exact definition of these forms. What one author calls the variety *nigra* another will consider the typical *pyramicus*. Quite often the typical *pyramicus* appears suspiciously like the subspecies *flavus*. It is possible to introduce still more complication into the problem by utilizing, as Wheeler did, Forel's subspecies *brunneus*. Although Wheeler never published on this form, there was much North American material in the Wheeler Collection which he had assigned to it. On such a basis we would have to deal with the following arrangement:

flavus McCook	pale yellow
pyramicus Roger	sordid brownish yellow
brunneus Forel	deep brown
nigra Pergande	brownish black

The arrangement may appeal to those who are not contented unless they have a name for every conceivable shade of color but from a practical standpoint it will not work. There is no sharp separation between these forms and good distinction can be secured only when extremes are compared. This observation is by no means based upon the writer's opinion alone. The literature abounds with references to intergrading conditions.

It seems to the writer that the first step toward the solution of this difficulty was taken by Dr. M. R. Smith when he described the subspecies *flavopectus*. While the color of this insect was distinctive, Dr. Smith presented definitive structural features which are much more important. The cephalic and thoracic characteristics of *flavopectus* are those of a geographical race of *pyramicus* which occurs in Florida and throughout the southern parts of the eastern Gulf States. In point of fact the color of this subspecies is inconstant, for most of the specimens have the color supposedly characteristic of *flavus*. The structural features are, however, not only clear-cut but also remarkably constant. This means that what we have been calling *flavus* is actually a composite of two different variants, the pale color phase of the typical *pyramicus* and the subspecies *flavopectus*. If *flavopectus* is marked by significant structural differences it is not unreasonable to suppose that comparable distinctions are present in other valid forms. Conversely, if there is nothing but a color difference to separate a form, its validity may be doubted. Unfortunately, this seems to be the case with several of them. Except for Wheeler's subspecies *bicolor*, which may be distinguished by its clypeal structure, there seems to be nothing but color which can be used to distinguish *flavus*, *nigra* or *smithi* from the typical *pyramicus* or, shall we say, from the form which has passed for the typical *pyramicus* among American myrmecologists. In an earlier paragraph I mentioned that there is room to doubt that the typical *pyramicus* occurs throughout the entire range of the species. From what has just been said concerning the taxonomy of this insect, it should be clear why such doubt may be entertained. European myrmecologists no less than our own have become involved in the maze of color variants which have been assigned to *pyramicus*. Since neither Mayr nor Forel appear to have seen Roger's types there is little to indicate that their 'typical *pyramicus*' is the same insect that Roger described or the same form to which that name is applied here. It behooves us to tread very softly in this matter, however, for if our version of the typical *pyramicus* is not identical with Roger's Brazilian types, then we are faced with the necessity of resuscitating Buckley's name *insana*. For Buckley was undoubtedly the first to give a name to the dark variant of *pyramicus* which occurs over much of the southern and southwestern United States. Since this looks suspiciously like stepping out of the frying-pan into the fire, I believe that most myrmecologists will be content to leave matters as they are in regard to the typical *pyramicus*.

Before leaving the taxonomy of Dorymyrmex, it is well to note that there seems little reason for the continued use of Forel's subgenus Conomyrma if Gallardo's genus Auracomyrmex is accepted. As I

understand the matter, Forel's subgenera in Dorymyrmex were designed to take care of certain South American species which lack the epinotal tooth (*tener*, etc). With these removed to the genus Auracomyrmex, all the remaining species would fall in Conomyrma, which would thus be coextensive with Dorymyrmex.

Wheeler once described *pyramicus* as an 'alert and self-assertive' ant and it would be hard to improve upon this characterization. Our forms are noted for their tendency to nest in dry soil or sand in fully exposed areas where many species find the conditions intolerable. They will, on occasion, resort to the surprising practice of establishing their nest on the side of a mound built by *Pogonomyrmex occidentalis*. No ant which was not alert and self-assertive could possibly hope to survive under such circumstances. The nests of *pyramicus* are usually surmounted by an irregular crater of excavated soil from two to four inches across. The ants are very active and predaceous but will feed on honeydew when they can get it. They have a strong odor of butyric acid which is particularly noticeable when they are crushed.

Key to the subspecies of Dorymyrmex pyramicus Roger

1. Mesonotum in profile rising through an even curve from the mesoepinotal suture, no abrupt declivious face present at the rear; occipital angles much rounded, only a small portion at the center of the occiput flat..... *pyramicus* subsp. *flavopectus*

   Mesonotum in profile rising abruptly from the mesoepinotal suture through a short, declivious, posterior face which forms a distinct angle with the more gently sloping dorsum; occipital angles only moderately rounded, the occiput flat or slightly concave for at least half the width of the head...2
2. Clypeus broadly and evenly rounded without a trace of median angle or carina; head and thorax deep, reddish yellow, the entire gaster brownish black..... *pyramicus* subsp. *bicolor*

   Clypeus distinctly angular or subcarinate in the middle; color very variable but never as described above..... *pyramicus*

1. Dorymyrmex pyramicus (Roger)

Prenolepis pyramica Roger, Berl. Ent. Zeitschr., Vol. 7, p. 160 (1863) ♀.

D. pyramicus Mayr, Sitz. Akad. Wiss. Wien, Vol. 53, p. 394 (1886); Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 365 (1886) ♀ ♀; Emery, Zool. Jahrb. Syst., Vol. 8, p. 331 (1895) ♂.

Formica insana Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 165 (1866) ♀ ♀.

D. flavus McCook, in Comstock, Rep. Cotton Insects, p. 188 (1879) ♀.

D. pyramicus var. *flavus* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 433 (1886).

D. pyramicus subsp. *flavus* Forel, Biol. Centrali Amer. Hym., Vol. 3, p. 103 (1899) ♀.

D. pyramicus var. *nigra* Pergande, Proc. Calif. Acad. Sci. (2), Vol. 5, p. 871 (1895) ♀.

D. pyramicus var. *smithi* Cole, Ent. News, Vol. 47, No. 5, p. 120 (1936) ♀.

Type loc: Bahia, Brazil. Types: none in this country.

Range: The range of the typical *pyramicus* in the United States is such a peculiar one that it cannot be summarized briefly. The insect is absent from the northeastern United States and its range begins in Illinois. To the west the range passes through Iowa, North Dakota, southern Montana and Idaho and the deserts of eastern Oregon. From this latitude south the range blankets the entire west. The range also runs southeastward from Illinois through Tennessee and the northern portions of Mississippi, Alabama and Georgia and the eastern part of South Carolina. The insect is exceedingly rare in the Gulf Coast region and Florida. There it is replaced by the subspecies *flavopectus*.

It seems well to note that the shape of the head in the typical *pyramicus* is subject to considerable variation. The occipital margin may be flat or broadly, although feebly, concave. The sides of the head are much more convex in some specimens than in others even in the same colony. There seems to be no connection between these variations and the color of the insect for they occur in both light and dark specimens. The thoracic structure, on the other hand, seems to be very constant (see key).

2. Dorymyrmex pyramicus bicolor Wheeler

D. pyramicus subsp. *bicolor* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 22, p. 342 (1906) ♀.

Type loc: Phoenix, Arizona (by present restriction). Types: M.C.Z.

Range: western Texas to southern California.

Although the range of the subspecies *bicolor* lies within that of the typical *pyramicus*, the two occupy separate stations because of the preference of *bicolor* for more arid nest sites. Mallis (1941) has contributed an interesting observation which has a bearing on this situation. He has found that *bicolor*, despite the fact that it nests in hot and very arid areas, will forage regardless of the temperature, while the typical *pyramicus* will often remain in the nest during exceptionally hot days. There would seem to be no doubt that *bicolor* is better adapted to desert life than is the typical form.

3. Dorymyrmex pyramicus flavopectus M. R. Smith

D. pyramicus subsp. *flavopectus* M. R. Smith, Florida Entomol., Vol. 27, No. 1, p. 15 (1944) ♀.

D. (*Conomyrma*) *pyramicus* subsp. *flavopectus* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 596, pl. 17, fig. 64 (1947) ♀.

Type loc: Archbold Biol. Sta., Lake Placid, Florida. Types: U.S.N.M.

Range: Florida and the southern portions of Alabama and Mississippi.

As I have already shown on a preceding page there has been confusion between this insect and the pale form of *pyramicus* which has been called *flavus*. It is possible that McCook's material contained specimens of *flavopectus* but, since most of it seems to have come from Texas, I do not think this is likely. While *flavopectus* is rather widely distributed in Florida its distribution in the eastern Gulf States seems to be limited to a narrow band about thirty miles wide extending inland from the coast. This area is marked by the presence of turpentine pines and palmettos and the soil is very sandy. The insect may occur along the coast of Texas but all the pale specimens which I have seen from Texas have belonged to the typical *pyramicus*.

Genus Tapinoma Förster

(Plate 48, figures 1–4)

Our few representatives of Tapinoma are largely untroubled by taxonomic difficulties, except for the insect which Wheeler described as *Bothriomyrmex dimmocki* in 1915. Ten years later Emery was able to show that *dimmocki* belonged to the genus Tapinoma but Emery made no attempt to assess the specific status of *dimmocki*. In 1947 Dr. M. R. Smith expressed the opinion that *dimmocki* might be nothing more than 'a pale, depauperate form of the common *sessile*.' It would considerably simplify matters if this proposition could be accepted but to do so involves certain discrepancies which are not easily explained. Chief among these is the remarkably small size of the female of *dimmocki*. This insect measures only 1.8 mm. in length and it is safe to assume that this was what misled Wheeler as to the generic affinities of *dimmocki*. Certainly the female of *dimmocki* is notably smaller than that of *sessile*. Dr. Smith, who has made an exceptionally careful study of *sessile*, gives the length of its female as 3.75–4.29 mm. But there are other differences which distinguish *dimmocki* from *sessile*. The clypeus of *dimmocki* has a sinuate rather than a clearly incised anterior border. The one type female with wings lacked the discoidal cell which is present in *sessile*. Both these latter character-

istics not only separate *dimmocki* from *sessile* but place it with the species in the *melanocephalum* group. It may be admitted, however, that the worker of *dimmocki* is not strikingly different from that of *sessile* and the difference in wing venation may prove inconstant when more material is available. Dr. Smith may, therefore, be correct in his view of *dimmocki* but, until it can be shown that the differences which mark the female are of no significance, it seems safer to treat it as a separate species.

Before turning to the habits of our representatives of Tapinoma, some cognizance must be taken of Wheeler's use of the subgenus Micromyrma. Originally Micromyrma was a generic synonym for Tapinoma which Dufour created in 1857. In 1887 Emery proposed to resuscitate Dufour's name to apply to a subgenus of Tapinoma which would include the species of the *melanocephalum* group. This proposal was made without knowledge that Dufour's Micromyrma was based upon the species *erraticum*, as is Tapinoma. In 1911 Wheeler established this fact when he published his paper on the type species of ants. Emery promptly dropped the subgenus Micromyrma but, oddly enough, Wheeler continued to use the subgenus for the rest of his life, although his work had clearly shown that it is improper to do so.

The habits of *sessile* have been exhaustively studied by Dr. M. R. Smith, whose account was published in 1928. Dr. Smith was able to determine that the average size of the colonies of *sessile* is between two thousand and five thousand individuals. The colonies are strongly pleometrotic with some colonies containing as many as two hundred deälated females. Dr. Smith believes that mating sometimes takes place in the nest and that this accounts for the large number of fertile females in a single colony. *T. sessile* is not at all particular about its nest sites and will nest in the soil, with or without a covering object, under bark and in all sorts of preformed cavities. It will also nest in houses and at times becomes a pest. Its elevational tolerance is remarkable. The insect occurs from sea level to sub-alpine areas. According to Dr. Smith the insect frequently changes its nest sites. The workers usually forage in files and are omnivorous although they appear to prefer honey-dew and sweet foods when they can get them.

The habits of the introduced *melanocephalum* are very similar to those of *sessile* but *littorale* seems to be a more arboreal species. It nests in hollow twigs, in the bases of epiphytes and in large, hollow, grass stems. It sometimes makes a carton entrance to the nest. It seems to feed mainly on honeydew secured from the secretions of aphids and coccids. While all three species are very energetic and not in the least timid they are less combative and bad tempered than

many ants. This probably accounts for the fact that they will, on occasion, form compound nests with other ants. All three species have the typical 'tapinoma odor' of butyric acid. Nothing is known about the habits of *dimmocki*.

Key to the species of Tapinoma

1. Antennal scapes not quite reaching the occipital border; color pale yellow to sordid yellow ..... *littorale*
   Antennal scapes surpassing the occipital border; color never as pale as described above 2
2. Gaster white or pale whitish yellow, distinctly lighter than the deep brown head and thorax ..... *melanocephalum*
   Gaster brown or brownish black, as dark or a little darker than the head and thorax 3
3. Anterior margin of the clypeus distinctly excised in the middle; length of worker 2–3 mm., that of female 4 mm ..... *sessile*
   Anterior margin of the clypeus sinuate in the middle but not distinctly excised; length of worker 1.8 mm., that of female 1.8 mm ..... *dimmocki*

1. Tapinoma dimmocki (Wheeler)

Bothriomyrmex dimmocki Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 417 (1915) ♀ ♀.
Type loc: Mt. Tom, Springfield, Massachusetts. Types: M.C.Z.
Range: known only from type material.

2. Tapinoma littorale Wheeler

T. littorale Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 109 (1905) ♀ ♀ ♂.
Type loc: Bahama Islands. Types: A.M.N.H., M.C.Z.
Range: southern Florida, Bahamas, Puerto Rico, etc.

3. Tapinoma melanocephalum (Fabricius)

(Introduced)

Formica melanocephala Fabricius, Ent. Syst., Vol. 2, p. 353 (1793) ♀.
T. melanocephalum Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 651 (1862); Forel, Mitt. München Ent. Verh., Vol. 5, p. 3 (1881) ♀; Emery, Ann. Stor. Nat. Genova, Vol. 24, p. 249 (1887) ♀ ♂; Forel, in Grandidier Hist. Madagascar, Vol. 20, p. 104 (1891) ♀ ♀; Bingham, Fauna Brit. India, Hym., Vol. 2, p. 304 (1903) ♀.
Formica melanocephala Latreille, Fourmis, p. 269 (1802) ♀.
Formica nana Jerdon, Madras Jour. Lit. Sci., Vol. 17, p. 125 (1851) ♀.

Myrmica pellucida F. Smith, Jour. Proc. Linn. Soc. Zool., Vol. 2, p. 71 (1857) ♀.
Formica familiaris F. Smith, Ibid., Vol. 4, Sup. p. 96 (1860) ♀.
Micromyrma melanocephalum Roger, Berl. Ent. Zeitschr., Vol. 6, p. 258 (1862) ♀ ♀.
Type loc: Cayenne. Types: none in this country.
Range: (in the United States) Florida only.

Although there seems to be no reason why this tropicopolitan species should not occur in many areas in the southern United States, its range appears to be limited to Florida. There it seems to be restricted to the southern part of the state for as yet no records from stations north of St. Petersburg have been published.

4. Tapinoma sessile (Say)

Formica sessilis Say, Bost. Jour. Nat. Hist., Vol. 1, p. 287 (1836) ♀.
T. sessilis F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 57 (1858).
T. sessile Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 434 (1886); Emery, Zool. Jahrb. Syst., Vol. 8, p. 332 (1895) ♀ ♂; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 21, p. 309, pl. 18, figs. 1–3 (1928) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 596, pl. 17, fig. 65 (1947) ♀.
T. boreale Roger, Berl. Ent. Zeitschr., Vol. 7, p. 165 (1863) ♀ ♀; Mayr, Sitz. Akad. Wiss. Wien, Vol. 53, p. 497 (1866) ♀.
Formica gracilis Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 158 (1866) ♀ ♀.
Formica parva Buckley, Ibid., Vol. 6, p. 159 (1866) ♀.
Type loc: Indiana. Types: none known to exist.
Range: southern Canada and the entire United States with the exception of desert areas in the southwest. The incidence of *sessile* appears to decrease sharply in the Gulf Coast region but it has been taken in Florida, Alabama, Mississippi and Texas.

Subfamily FORMICINAE

The majority of our species which belong to the Subfamily Formicinae are referable to the genera Formica or Camponotus. Although the Subfamily has only nine genera in America north of Mexico, there are so many species in the two genera just mentioned that the total representation in the Formicinae is only a little less than that in the Myrmicinae, where thirty-two genera are involved. While the structure of the genera in the Formicinae is not strongly variable their habits are highly diverse. Generally this diversity cuts across generic or subgeneric lines. For example, there is temporary social parasitism in certain species of Formica and Lasius, although this characteristic is not found in all members of either genus. The capacity for pro-

ducing repletes is encountered in Prenolepis and many of the species of Myrmecocystus, yet a considerable proportion of the species in the latter genus appear to be carnivorous. Slave-making may be obligatory, as in Polyergus, or facultative, as in the case of certain species of Formica. An adaptation to an underground existence has been made in the case of Acanthomyops and certain species of Lasius, whose workers appear on the surface of the soil only at the time of nuptial flight. In such cases the ants usually tend root aphids and utilize the secretions of these insects as one of their main sources of food. The members of several subgenera of Camponotus show various degrees of adaptation to an arboreal life, culminating in the highly developed subgenus Colobopsis, whose bizarre major workers are among our most extraordinary ants.

Before presenting the key to the genera I wish to comment on certain departures from time-honored practices which it embodies. For the past half century it has been customary to utilize the relationship of the clypeal and antennal fossae as a distinguishing character for certain tribes and genera. The fossae are said to be either separate or confluent and the division has been based on this difference. There is no doubt that the distinction will apply clearly in certain cases. In Camponotus, where the antennae are ordinarily inserted well behind the posterior edge of the clypeus, the two fossae are usually separated by a low, rounded elevation whose posterior face bounds the front of the antennal fossa and whose anterior face descends to the suture at the rear of the clypeus. In Formica and Polyergus, where the scapes are always inserted close to the rear border of the clypeus, the reverse is true. The clypeal and antennal fossae are clearly confluent. It is somewhat ironical to note that, as far as our representatives are concerned, it is not necessary to utilize the difference just mentioned to separate any one of the three genera. There are other and better characters by which they may be recognized. But the situation is altogether different in the case of the tribe Prenolepidini. It is customary to separate this tribe from the Formicini because of the supposed lack of confluence of the clypeal and antennal fossae in the former group. This practice has all the ear-marks of a desperation measure. The tribe Prenolepidini is a very difficult one to handle for it seems to have nothing but negative characteristics to mark it. This lack of distinction is equally true of the character of the clypeal and antennal fossae. In most of the species belonging to the Prenolepidini the frontal carinae are obscure and the fossae which they surmount are shallow and small. The front of the fossa is generally closed by the insertion of the antenna and, to this extent, it may be said that the antennal fossa is not confluent with the clypeal fossa.

But there is no distinct ridge separating the two, as in Camponotus, and the general configuration of the two fossae is more nearly like that of the Formicini. The attempt to utilize this character in the case of the Prenolepidini has not been a particularly happy one for it has given this character a bad reputation and damaged its value in those instances where it will clearly apply. I have made no attempt to employ it in the following key because, from a practical standpoint, our few representatives of the Prenolepidini can be handled much more easily by using other separatory characters.

I have also made a limited use of the position of the antennal insertions. The principal tribal character of the Camponotini is said to be the fact that the antennae are inserted well behind the posterior border of the clypeus. They usually are, but there are many exceptions to this rule. Most of the species in the genus Opisthopsis fail to show this character and there are several other exotic genera which fail to agree. Indeed the only genus in which the character appears to hold throughout is Polyrhachis. Most of our species of Camponotus agree reasonably well but, even within this limited segment of the group, there is considerable variation in the space which separates the insertion of the antenna from the posterior border of the clypeus. That we have been willing to accept this character as definitive for the Camponotini seems to indicate that for practical purposes we have been using other criteria as a means for recognizing the members of this tribe. I make no claim that the distinctions employed to separate Camponotus in the following key are generally applicable, but I do believe that they will give an easier and more certain separation than is possible if the position of the antennal insertion is used alone.

Key to the Genera in the Subfamily Formicinae

1. Antennae with nine segments ..... *Brachymyrmex*
   Antennae with twelve segments 2
2. Thoracic dorsum, in profile, evenly convex, the epinotum not depressed below the level of the promesonotum, the mesoepinotal suture unimpressed or very slightly impressed[1]; mesothoracic spiracles borne on the sides of the thorax at a level well below the basal face of the epinotum; the antennal scapes usually inserted well behind the posterior edge of the clypeus ..... *Camponotus*

   Thoracic dorsum, in profile, with the epinotum distinctly depressed below the level of the promesonotum; the impression at the mesoepinotal suture always distinct and often profound; mesonotal spiracles usually occurring

[1] In certain species of the subgenus Colobopsis the epinotum is depressed and the mesoepinotal suture is rather strongly impressed, especially in the minor worker. In such cases, however, the head of the major is cylindrical and truncate anteriorly.

in this impression on or close to the dorsal surface of the thorax; antennal scapes inserted at or near the posterior border of the clypeus.....3

3. Mandibles sickle-shaped, their inner border microscopically serrate; maxillary palps with four segments, labial palps with two segments...*Polyergus*
Mandibles triangular with a distinctly dentate masticatory margin; maxillary and labial palps with a different number of segments.....4
4. Maxillary palps very short and consisting of three segments..*Acanthomyops*
Maxillary palps longer and consisting of six segments.....5
5. Maxillary palps longer than the head, the third and fourth segments very long; each of the above segments as long or longer than the two terminal segments combined; psammophore present.....*Myrmecocystus*
Maxillary palps shorter, or at least no longer, than the head, the third and fourth segments not unusually long; psammophore absent.....6
6. Frontal carinae prominent, their lateral margins slightly reflected upward; ocelli very distinct.....*Formica*
Frontal carinae poorly marked, their lateral margins flat; ocelli indistinct or absent.....7
7. Antennal scapes surpassing the occipital margin by at least one-third their length, usually much longer; erect body hairs coarse, long and usually brown or black in color.....8
Antennal scapes never surpassing the occipital margin by an amount greater than the length of the first funicular joint, often much shorter; erect body hairs not coarse, short and golden.....*Lasius*
8. Thorax seen from above with the mesonotum very strongly compressed..*Prenolepis*
Thorax seen from above with the mesonotum only slightly compressed...*Paratrechina*

Genus BRACHYMYRMEX Mayr

(Plate 49, figures 1–4)

The genus Brachymyrmex is composed entirely of species native to the New World. These tiny ants are easily transported in living plant material and two species (*longicornis* and *heeri*) were first described by Forel from colonies imported to European greenhouses. From a taxonomic point of view the genus is an exceptionally difficult one. The minute, highly specialized workers not only fail to show good separatory characters but are so constructed that ordinary methods of measurement often have little significance. The majority of the species of Brachymyrmex do not exceed 2 mm. in total length and many of them are only a little more than 1 mm. long. In addition to the small size, one must deal with a flabby and voluminous gaster which, in the living specimen, is usually about twice as long as the head and thorax. On drying the gaster may shrink to half of its former length or may remain extended, though flattened. Under such

circumstances it is easy to appreciate that over-all measurements of length, expressed in millimeters, have little meaning in the case of dried specimens. It seems likely that future work on the taxonomy of Brachymyrmex will involve measurement of the head and thorax in terms of microns. If the ensuing discussion appears hypercritical, it is not because of a lack of appreciation for the work of those who have dealt with this miserable little genus. It would appear, however, that the literature which treats of our two described forms is in considerable need of revision.

In 1893 Emery described *depilis*, which he made a subspecies of Forel's *heeri*. No specific type locality was cited for *depilis* but Emery observed that Pergande had sent him material from the District of Columbia, Dakota, New Jersey and Virginia. Emery's characterization of *depilis* was of the briefest sort and consisted only of the statement that the new subspecies could be separated from the typical *heeri* by the complete lack of erect hairs on the thorax. It has been possible to avoid confusion in the case of *depilis* mainly because it is the only species which occurs in the northeastern United States. Ten years after *depilis* was described Wheeler set up a second species which he called *nanellus*. Wheeler's description of *nanellus* was accompanied by a figure of the head of the worker as well as a figure of the head of a worker that Wheeler called *depilis*. I shall refer to these figures in a following paragraph for they played a large part in subsequent developments. No additional descriptive material covering either species appeared in the literature until 1923. In that year Santschi brought out his monograph on Brachymyrmex. In this monograph he raised *depilis* to specific rank and presented a short description of the worker caste. The material on which this description was based was taken in North Carolina and identified by Forel. It may be noted that Santschi's description of *depilis* agrees well with specimens which come from the northeastern United States.

What Santschi did with *nanellus* is quite another matter. It is obvious that he had no specimens that he could refer to this species and so he was forced to rely on Wheeler's description and figure. This would have been bad enough in itself, for both are inaccurate, but Santschi had the additional bad luck of misunderstanding Wheeler's description. Wheeler stated that the eye of *nanellus* has about six ommatidia in its greatest diameter. It is by no means easy to make exact counts of the number of ommatidia in the eye because those at the rim are often unpigmented and poorly defined. In any case there are always at least twenty well-defined ommatidia present and the number may run as high as forty when the eye is fully pigmented. In Santschi's description, however, the eye of *nanellus* was said to con-

sist of six facets. This error was repeated in the key, where *nanellus* is separated from *myops* because it has eyes consisting of eight (not six) facets, while the eye of *myops* has fifteen. For this mistake Santschi had himself to blame but he cannot be blamed for repeating other errors included in the original description and figure of *nanellus*. According to Wheeler, *nanellus* can be distinguished from *depilis* because it is smaller, paler, with shorter funicular joints and shorter maxillary palps and the male is paler than that of *depilis*. To these five differences may be added a sixth which was shown in the figure. The occipital margin of *nanellus* is shown as feebly convex in marked contrast to the slightly concave occipital border of *depilis*.

In preparing this work I have had occasion to examine a large number of specimens of Brachymyrmex coming from widely separated stations in the United States. Among these were the types of *nanellus* and other specimens identified by Wheeler as *nanellus*. The results of this study were discouraging for they strongly indicated that *nanellus* and *depilis* are specifically identical. Moreover, it soon became apparent that most of the criteria for the separation of *nanellus* which Wheeler cited are suspect. The occipital border of *nanellus* is slightly concave, not convex. The maxillary palps in *nanellus* are fully as long as those of *depilis*. The size range of the two appears to be identical and while I have seen no specimens of *nanellus* which are as dark as some of the eastern representatives of *depilis*, the latter form frequently throws pale variants which are fully as light as *nanellus*. I was at considerable pains to measure the funicular joints in the two forms, since the distinction there seemed to be a positive one that might permit specific separation. The funiculi are covered by dense, short hairs which reflect light and it is necessary, if accurate measurements are to be made, to immerse the insect in some liquid which will reduce the scattering of light by the hairs. For this reason the measurements cited below were not taken from type specimens. I believe, however, that they are reliable, since the specimens used had been compared with the types of *nanellus*. It may be recalled that Wheeler stated that funicular joints 2–6 were not longer than broad in *nanellus*. His figure is exceptionally confusing in this matter since the left funiculus shows these joints a little longer than broad while the right funiculus has joints three, four and five as broad as long. My measurements showed that funicular joints 2–6 are all slightly longer than broad with the exception of number three which is sometimes as broad as long. Exactly the same proportions were observed in the funicular joints of *depilis*. This led to the question of how Wheeler had been able to figure *depilis* with a funiculus in which the joints are notably longer than broad. I believe that in this figure lies the answer to the entire

tangle. Unless I am very much mistaken, the insect which Wheeler regarded as *depilis* at the time when he described *nanellus* was actually *heeri obscurior*. This Mexican subspecies is slightly larger and notably darker than *depilis* and the funicular joints are distinctly longer than broad. In this connection it is worth noting that Wheeler stated that *depilis* is distinctly brown in color. This is certainly not the case with the material which I have examined. Even in fresh specimens the darkest individuals are sordid greyish or brownish yellow and certainly not brown. While it may seem unlikely that Wheeler should have confused *obscurior* with *depilis*, it is well to recall that up to 1903, when *nanellus* was described, most of Wheeler's myrmecological efforts had been confined to the ants of Texas and Mexico. His extensive studies of the ants of the eastern United States were still to come. It is, therefore, not improbable that he was better acquainted with *obscurior* than with *depilis*.

In any case, I am convinced that *nanellus* cannot be regarded as a separate species nor do I think that it is subspecifically distinct from *depilis*. The only suggestive lead along this line appears to lie in the slightly larger eyes of some of the Texas specimens. The increased size of the eye is not due to a greater number of facets but rather to the greater size and wider spacing of the individual facets. As these individuals occur at random within a population having small facets in the eyes, no definitive range can be assigned to them. This variation, like that of color, apparently cannot be correlated with geographical distribution. For the above reasons I have synonymized *nanellus* with *depilis*.

1. Brachymyrmex depilis Emery

B. heeri subsp. *depilis* Emery, Zool. Jahrb. Syst., Vol. 7, p. 635 (1893) ♀ ♀ ♂; Wheeler, Psyche, Vol. 10, p. 103, fig. 7a (1903) ♀.

B. depilis Santschi, Ann. Mus. Hist. Nat. Buenos-Aires, Vol. 31, p. 653, fig. 22 (1923) ♀.

B. nanellus Wheeler, Psyche, Vol. 10, p. 102, fig. 7b (1903) ♀ ♂; Santschi, Ann. Mus. Hist. Nat. Buenos-Aires, Vol. 31, p. 664 (1923) ♀.

Type loc: District of Columbia (by present restriction). Types: none in this country.

Range: New England southward to Texas, New Mexico and Colorado.

Genus Camponotus Mayr

(Plate 50, figures 1–6)

Of the many subgenera now recognized as belonging to Camponotus only eight are represented in America north of Mexico. The over-

whelming majority of our species are found in the four subgenera Camponotus, Tanaemyrmex, Myrmentoma and Colobopsis, with the remaining four, Myrmothrix, Manniella, Myrmaphaenus and Myrmobrachys containing only seven forms among them. For this reason the last four subgenera offer little difficulty from a taxonomic standpoint. Unfortunately this is not true of three of the four subgenera in the first group for, with the exception of Colobopsis, the others are marked by much intricate and confusing taxonomy. Not only has there been need for considerable revision within these groups but it has also been necessary to revise the constitution of two of them. I cannot agree with Emery's treatment of the subgenus Camponotus and, since the plan followed here differs from that proposed by Emery in the *Genera Insectorum*, I wish to consider briefly some of the steps by which Emery arrived at his arrangement.

When the formicine section of the *Genera Insectorum* appeared in 1925, it brought to a conclusion the revisionary work on the genus Camponotus which had been begun by Emery thirty years earlier. In 1896 he had published a remarkably comprehensive plan for breaking up Camponotus into twenty-six subdivisions. These smaller units, which Emery called "maniples", were in many cases identical with our present subgenera. They were in large part based on a combination of structural and geographical considerations and it is to be regretted that Emery did not name them. Had he done so, much subsequent confusion might have been avoided. However, at that time the subgenus was little used and Emery was content to leave his subdivisions nameless. In the first quarter of the present century the genus Camponotus underwent severe growing pains. It swelled to such unwieldy proportions that the subdivision of this vast agglomeration of species became imperative. At different times Ashmead, Wheeler, Forel, Emery and Santschi all published proposals to recognize subgeneric groups. Some of these suggestions were not very helpful, for both Wheeler and Ashmead would establish subgenera by simply designating a subgenotype, a practice which Emery later referred to as a "mode funestre anglo-americane". The bulk of the work fell upon Forel and Emery but even these two workers, who collaborated rather closely, did not always agree as to what species the various subgenera should include. The period from 1900 to 1920 was, therefore, a confused one as far as the subgenera of Camponotus were concerned, since the delimitation of the groups varied with the opinions of the several specialists involved. In 1920 the situation was materially improved when Emery published a very careful study in which the structural criteria of most of the present subgenera were given. This resolved much of the confusion and with the appearance of the formicine section

of the *Genera Insectorum* in 1925, an even better basis for general agreement was made available. There was good reason for profound satisfaction at Emery's masterly handling of this difficult matter for it stabilized the subgenera and largely put an end to the constant shifting about of species which had marked the earlier studies in this group. The widespread acceptance of Emery's scheme may be taken as proof that most myrmecologists regard the matter of stability as highly important, for Emery's arrangement is, in the last analysis, based in many cases upon an arbitrary division of intergrading groups. It is clearly impossible to secure sharp distinction between many of the subgenera, yet most students of ants have been willing to accept this fact for the sake of the stability and ease of handling which Emery's arrangement permits. I was fully prepared to do so in this work until it became necessary to bring up to date the keys for our species which Wheeler had presented in 1910. It then became apparent that Emery had made an error in his treatment of some of the North American species which he allocated to the subgenus Camponotus. It may be admitted that this subgenus intergrades with Tanaemyrmex and this gives a certain amount of leeway as to how the species are to be treated. But I believe that it can be shown that the structural relation of a number of the forms which Emery placed in Camponotus is with Tanaemyrmex. Emery himself originally recognized this relationship, for he described several variants in the *sansabeanus* complex, all of which he made subspecies or varieties of *maculatus*. Although Emery later placed *maculatus* in the subgenus Tanaemyrmex, only one of the variants (*tortuganus*) which he had previously assigned to it was so treated. The rest were shifted to the subgenus Camponotus. It seems peculiar that, if the structural similarity of these variants was close enough to allow them to be regarded as infraspecific forms of *maculatus* when first described, they should later be placed in a separate subgenus. I do not propose that they be returned to *maculatus* but I do propose to place them in the subgenus Tanaemyrmex, where they properly belong.

My view is based largely upon the cephalic structure in the two groups. In the species which I regard as belonging to the subgenus Camponotus the clypeus is ecarinate or so nearly ecarinate that it is difficult to discern more than a trace of median carina. The clypeal fossae are well developed, so that the clypeus stands out sharply from the lateral portions of the head which flank it. The antennal scapes are never flattened at the base. The head of the major worker is at least a little broader than long and often considerably broader than long. In the case of the species which I have transferred to Tanaemyrmex, there is less uniformity of structure. In general these species

show a distinct median clypeal carina. In those which do not, the base of the antennal scape is flattened. The antennal fossae are usually shallow, particularly toward the top of the clypeus. Hence the clypeus is not so sharply separated from the flanking portions of the head as it is in the subgenus Camponotus. The head of the major worker is rarely broader than long. It may be as broad as long or, as is usually the case, notably longer than broad. Since these characters agree very closely with those of one type of major worker which Emery regarded as typical of the subgenus Tanaemyrmex (his β type worker), I cannot see why he felt it necessary to assign the species of the *sansabeanus* complex to the subgenus Camponotus.

It is also puzzling that Emery, who made such extensive use of geographical distribution in setting up subgenera in Camponotus, should have failed to appreciate the distributional difference which separates the North American representatives of Tanaemyrmex and Camponotus. In general, the subgenus Camponotus is boreal and eastern while our species of Tanaemyrmex are southern and western. There is remarkably little overlap in the two groups. Both occur together in the southeastern United States, particularly in the eastern Gulf States and Florida, but this is the only region where there is anything approaching an equal representation. Camponotus occurs widely throughout Canada, the northern and northeastern United States and at considerable elevations in the mountains in the western states. Representatives of Tanaemyrmex are absent or extremely rare in this region. Tanaemyrmex, on the other hand, abounds in dry or semi-desert areas in the southwestern and western states. It rarely occurs at high elevations in the western mountains, even in southern latitudes. The two groups are, therefore, more sharply separated than might be supposed from a hasty consideration of their distributional characteristics. I make no claim that the arrangement presented in this work represents an altogether satisfactory solution of the problem. I feel certain, however, that it checks more closely with facts of structure and distribution than does the plan presented by Emery in the formicine section of the *Genera Insectorum.*

Key to the Subgenera of Camponotus

1. Head of the major circular in cross section and abruptly truncated in front; the truncated portion consisting of the clypeus and adjacent parts of the cheeks with the mandibles forming the ventral segment; medias absent.. Subgenus *Colobopsis*

   Head of the major not circular in cross section and not abruptly truncated in front; if truncated the slant is oblique and involves the frontal lobes as well as the clypeus; medias present.....2

2. Front of the head of the major obliquely truncate, the truncation involving the frontal lobes; clypeus flat and scarcely higher than the adjacent portions of the cheeks 3
   Front of the head of the major not obliquely truncate, more or less convex; clypeus convex or angular and distinctly higher than the adjacent portions of the cheeks 4
3. Head of the major with a large, bordered, concave hollow at either side which extends across the cheek from the insertion of the antenna to the level of the middle of the clypeus ..... Subgenus *Manniella*
   Head of the major without the concave hollow described above ..... Subgenus *Myrmaphaenus*
4. Scapes and legs with numerous, long, coarse, brownish or golden erect hairs on all surfaces ..... Subgenus *Myrmothrix*
   Erect hairs on scapes and legs, when present, fine, short and usually whitish, often confined to a row of bristles on the flexor surface of the legs 5
5. Thorax short, that of the major worker no longer than the head (mandibles excluded); humeral angles of the thorax well marked ..... Subgenus *Myrmobrachys*
   Thorax longer, that of the major worker longer than the head (mandibles excluded); humeral angles of the thorax usually much rounded 6
6. Anterior border of the clypeus feebly prôjecting, depressed in the middle and with a narrow, median notch, behind which is a short, triangular impression; length of the major worker at most 8 mm. ..... Subgenus *Myrmentoma*
   Anterior border of the clypeus not as above, usually without a median notch but when one is present there is no impression behind it; length of the major worker rarely less than 8 mm. and usually much more 7
7. Clypeus ecarinate or scarcely carinate; antennal scapes never flattened at the base; clypeal fossae well marked; head of the major worker (mandibles excluded) at least a little broader than long ..... Subgenus *Camponotus*
   Clypeus distinctly carinate or if feebly carinate the antennal scape is flattened at the base; antennal fossae shallow over most of their length; head of the major worker (mandibles excluded) as long as broad or distinctly longer than broad ..... Subgenus *Tanaemyrmex*

Subgenus CAMPONOTUS Mayr

A considerable amount of revisionary work has been necessary in the case of this subgenus. I have referred elsewhere to the reasons which have led to the transfer of a number of species to Tanaemyrmex. Aside from these changes, there are others which have been necessary. Some of these arise from the practice of using the species *herculeanus* as a catch-all for any form whose exact status has been doubtful. Others stem from a lack of appreciation for the significance of color variation in several of the species. In early years little material was

available and it is not surprising that some of these color variants were given varietal status. There is now no possible justification for this practice, yet it is still followed. Thus in 1936 Santschi set up a new subspecies of *castaneus* which he called *rufinasis*. This insect is an obvious synonym of the well-known *americanus*, whose highly variable coloration has been recognized and repeatedly commented upon since 1862. Finally, I have found it necessary to transfer *texanus* and *schaefferi* to this subgenus. Actually *texanus* is a transitional species which links the subgenera Camponotus and Myrmentoma, hence its inclusion in either group is defensible. In my opinion, however, there is less chance for confusion if *texanus* is assigned to the subgenus Camponotus.

The habits of the members of the subgenus Camponotus are not very uniform. Most of them build nests in decaying wood, which gives them their common name "carpenter ants". In this connection it seems worthwhile to note that the destructive capacities of these insects have been somewhat exaggerated. It is true that they frequently tunnel their nest passages in the timbers and wood-work of buildings and the excavations may be so extensive that large beams may be reduced to rotten shells. But it has been my experience that the passages are rarely, if ever, driven into sound, dry wood. The presence of a nest of carpenter ants in the wood-work of a building is almost certain evidence that the infested area has been previously wet to the point of decay. The work of the ants has merely hastened a process of disintegration which would have ultimately occurred even if they had not been present. No properly constructed building in which the timbers are sound and dry is in any danger of ravages from carpenter ants. Because these ants excavate only the soft and rotting parts of the wood their nests which occur in logs or trees are often very diffuse, with the passages following areas of decay which may extend through many feet of sound wood. The species which nest in wood rarely make passages in the soil, even when the log containing the nest is partly buried. The reverse situation is true of *americanus* which nests by preference in soil. The nests are usually constructed under stones or fallen logs but in the latter case few of the passages enter the log. Our species belonging to the subgenus Camponotus may be separated as follows:

Key to the species of Camponotus

1. Major worker with the anterior margin of the median lobe of the clypeus straight or evenly concave, the angles which the median portion makes with the lateral portions sharp and tooth-like 2

Major worker with the anterior margin of the clypeus not as described above, the anterior edge of the median lobe usually scalloped and meeting the lateral portions in blunt angles 3

2. Median lobe of the clypeus with a concave anterior edge in the major worker and female; head and gaster at least in part blackish, thorax and legs deep red ..... *texanus*
   Median lobe of the clypeus with a straight anterior edge in the major worker and female; entire insect yellowish red ..... *schaefferi*
3. Antennal scapes with a number of short, scattered, erect hairs present; entire insect jet black and very shining, often with strong bluish reflections *laevigatus*
   Antennal scapes without erect hairs present except for a small cluster at the extreme tip; color not as above or, if uniform black, the surface is not strongly shining 4
4. The antennal scapes of the major worker reaching or barely surpassing the occipital corners ..... *herculeanus*
   The antennal scapes of the major worker surpassing the occipital corners by an amount greater than their maximum diameter 5
5. Pubescence on the gaster absent or very fine and sparse, the entire surface of the gaster distinctly shining 6
   Pubescence on the gaster coarse and dense, the surface of the gaster dull except for a narrow band at the posterior edge of each segment 7
6. Punctures on the head coarse and conspicuous; head and gaster brownish black, thorax red ..... *noveboracensis*
   Punctures on the head fine and inconspicuous; color very variable but the thorax never red ..... *americanus*
7. Pubescence on the gaster less than half as long as the erect hairs ..... *pennsylvanicus* subsp. *modoc*
   Pubescence on the gaster about as long as the erect hairs 8
8. Head, thorax, petiole and gaster dull black, pubescence pale yellow or white ..... *pennsylvanicus*
   Posterior portion of the thorax, petiole and base of the first gastric segment bright, ferrugineous red; pubescence golden yellow ..... *pennsylvanicus* subsp. *ferruginea*

1. Camponotus americanus Mayr

C. americanus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 661 (1862) ♀ ♀.
C. castaneus Mayr (part), Ibid., Vol. 36, p. 420 (1886).
C. castaneus subsp. *americanus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 674 (1893) ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 323 (1910) ♀ ♀ ♂.
C. castaneus subsp. *rufinasis* Santschi, Rev. Entomol., Vol. 6, fasc. 2, p. 204 (1936) ♀ ♀.

Type loc: New Orleans, Louisiana. Types: none in this country.

Range: New England and southern Ontario south to the Gulf Coast and as far west as Iowa, Missouri, Oklahoma and Texas.

It is difficult to see why Wheeler was willing to accept Emery's treatment of *americanus*. The insect has little in common with *castaneus* which, in my opinion, belongs to the subgenus Tanaemyrmex. The head of the major worker of *americanus* is slightly broader than long and it lacks the very prominent median impression or excavation which is present in *castaneus*. The clypeus of the major is virtually ecarinate, although there is a small ridge immediately in advance of the frontal area which may represent the carina. Since Wheeler had a great deal of material of both *americanus* and *castaneus* in 1910 it seems scarcely credible that he should have failed to comment on the notable differences which distinguish these two insects. On the contrary he stated that he could find no difference other than a very slight distinction in the cephalic sculpture and the color of *americanus*. It is interesting to note that Wheeler would have reduced *americanus* to varietal status except for the fact that he could not find intergrades between it and *castaneus*. Since the ranges of the two insects are coincidental over much of the eastern United States, this fact in itself, should have suggested that they are separate species. There is no room for doubt on this point and, while there may be some objection to the transfer of *castaneus* to the subgenus Tanaemyrmex, there can be none to according *americanus* the specific status which it deserves. I have already shown that Santschi's *rufinasis* is one of the innumerable color variants which *americanus* throws over its entire range. There is nothing whatever to indicate that *rufinasis* is a geographical race and it must be regarded as a synonym of *americanus*.

2. Camponotus herculeanus (Linné)

Formica herculeana Linné, Syst. Nat. Ed. 10, Vol. 1, p. 579 (1758) ♀; Fabricius, Syst. Ent., p. 391 (1775); Fabricius, Ent. Syst., Vol. 2, p. 349 (1793); Fabricius, Syst. Piez., p. 395 (1804); Nylander, Acta. Soc. Sci. Fenn., Vol. 2, p. 894, pl. 18, figs. 1, 8 (1846) ♀ ♀ ♂; Nylander, Ann. Sci. Nat. Zool. (4), Vol. 5, p. 56 (1856) ♀ ♀ ♂; Schenk, Jahrb. Ver. Natur. Nassau, Vol. 8, p. 123 (1852) ♀ ♀ ♂; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 5, p. 308 (1855) ♀ ♀ ♂.

Camponotus herculeanus Mayr, Europ. Formicid, p. 36 (1861); Forel, Fourmis Suisse, p. 39 (1874); Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 57 (1879); E. André, Spec. Hym. Europe, Vol. 12, p. 154 (1882); Emery, Zool. Jahrb. Syst., Vol. 7, p. 674 (1893); Ruzsky, Formicar. Imp. Ross, p. 214 (1905); Emery, Deutsche Ent. Zeitschr., p. 184 (1908); Forel, Fauna Ins. Helvet. Hym. Formicid, p. 68 (1915); Emery, Bull. Soc. Ent. Ital., Vol. 47, p. 225 (1916); Bondroit, Ann. Soc. Ent. Fr., Vol. 87, p. 70 (1918). All the above references are for ♀ ♀ ♂.

C. herculeanus subsp. *pennsylvanicus* var. *whymperi* Forel, Trans. Ent. Soc. Lond., p. 699 (1902) ♀ ♀.

C. herculeanus var. *whymperi* Emery, Deutsche Ent. Zeitschr., p. 184 (1908) ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 330 (1910) ♀ ♀ ♂.

? *Formica semipunctata* Kirby, Fauna Bor. Amer., Vol. 4, p. 262 (1837) ♀.

? *Camponotus semipunctatus* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 13, p. 401 (1863).

Type loc: Europe. Types: none in this country.

Range: in North America, Alaska and Canada with southern extensions through the mountains in both the eastern and western United States. In the west this southern fringe extends to the mountains of New Mexico. In the east it apparently terminates in the mountains of Pennsylvania.

Since Wheeler clearly demonstrated in 1910 that *whymperi* cannot be separated from the typical *herculeanus*, I can see no reason why he and other myrmecologists have continued to recognize Forel's synonym. While it is convenient to have a name that distinguishes the American specimens of *herculeanus* from those of Europe, this is a poor excuse for a practice which is both misleading and contrary to the rules of nomenclature. In this volume *whymperi* has been treated as a synonym of *herculeanus*.

3. Camponotus pennsylvanicus (DeGeer)

Formica pennsylvanica DeGeer, Mem. Hist. Insect., Vol. 3, p. 603, pl. 31, figs. 9, 10 (1773) ♀ ♀ ♂; Olivier, Encycl. Méth. Insect., Vol. 6, p. 501 (1791); McCook, Trans. Amer. Ent. Soc., Vol. 5, p. 277, pl. 2–4 (1876).

C. pennsylvanicus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 666 (1862) ♀ ♀; E. André, Spec. Hym. Europe, Vol. 2, p. 141, 153 (1882) ♀ ♀.

C. herculeanus subsp. *pennsylvanicus* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 57 (1879); Emery, Zool. Jahrb. Syst., Vol. 7, p. 675 (1893); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 335 (1910) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 604, pl. 18, fig. 67 (1947) ♀.

C. herculeanus var. *herculeano-pennsylvanicus* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 56 (1879); Emery, Zool. Jahrb. Syst., Vol. 7, p. 668 (1893).

C. herculeanus var. *mahican* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 338 (1910) ♀.

Type loc: Pennsylvania. Types: none in this country.

Range: eastern United States and southern Canada as far west as the hundredth meridian and south to the eastern Gulf States.

There are several reasons why *pennsylvanicus* must be given the specific status originally accorded it, although its long association with *herculeanus* makes this somewhat difficult. I believe that Forel was entirely incorrect in treating *pennsylvanicus* as a subspecies of

herculeanus. In the first place the two insects are easily separable on the basis of scape length. The antennal scapes of *herculeanus* are much shorter than those of *pennsylvanicus* and there seems to be no evidence that this character intergrades. It may be recalled that Forel thought he had found intergrades between *herculeanus* and *pennsylvanicus,* to which he gave the name *herculeano-pennsylvanicus*. These supposed intergrades were, however, based entirely upon differences in sculpture and pilosity. Moreover, they cannot possibly have been intergrades between the two insects for they were taken in an area (South Carolina) well to the south of the range of *herculeanus*. In my opinion these 'intergrades' clearly belong to the typical *pennsylvanicus* and have no bearing on the problem of the behavior of that species and *herculeanus*. For if intergrades between these two species occurred one would expect to find them in the northeastern United States. The southern limit of the range of *herculeanus* reaches the mountains of Pennsylvania. There is thus a considerable area in the northeastern United States where that insect and *pennsylvanicus* coexist. I have never seen the slightest indication that intergrades are produced in the above region. On the contrary the two insects appear to maintain their characteristics with remarkable clarity. In addition to the longer scapes of *pennsylvanicus* there is another difference shown by the females of the two insects. The female of *pennsylvanicus* is more heavily sculptured, with the head and thorax dull. The female of *herculeanus* has a lighter sculpture, particularly on the thorax, which is almost as shining as that of *noveboracensis* in some specimens. The color of the female of *herculeanus* is rather variable but it usually shows considerable red on the thorax, which provides a further distinction from *pennsylvanicus,* where the thorax of the female in the typical form is entirely black.

4. Camponotus pennsylvanicus ferruginea (Fabricius)

Formica ferruginea Fabricius, Suppl. Ent. Syst., p. 279 (1798) ♀ ♀; Latreille, Fourmis, p. 94 (1802).

Camponotus ferrugineus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 13, p. 399(1863).

C. herculeanus subsp. *pennsylvanicus* var. *ferruginea* Emery, Zool. Jahrb. Syst., Vol. 7, p. 668 (1893); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 338 (1910) ♀ ♀ ♂.

Type loc: 'America'. Types: none in this country.

Range: northeastern states west to Illinois and south toVirginia and Tennessee.

I have departed from the practice followed elsewhere in this work and retained *ferruginea* as a subspecies even though it is clear that it

is not a geographical race. The range of *ferruginea* is blanketed by that of the typical *pennsylvanicus*, yet the two insects show no tendency toward intergradation. Although the two behave as species I cannot, as yet, see anything except the striking and beautiful coloration of *ferruginea* by which they can be separated. Since color is such a notoriously bad separatory character in the case of ants, I do not care to consider *ferruginea* as a species on this basis alone. If subsequent work reveals other differences, *ferruginea* will have to be given specific status. In the meantime it seems best to treat it as a subspecies.

5. Camponotus pennsylvanicus modoc Wheeler

C. herculeanus subsp. *pennsylvanicus* var. *semipunctatus* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 57 (1879); Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 152 (1904) (*nec* Kirby).

C. herculeanus subsp. *modoc* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 333 (1910) ♀ ♀ ♂.

Type loc: California (by Wheeler's designation). Types: none in this country.
Range: Pacific Coast States east to the Rockies.

There is some question as to whether *modoc* ought to be considered as a race of *pennsylvanicus* for the ranges of the two insects do not seem to overlap. There are as yet no records of *modoc* from the east of the Rockies or any for *pennsylvanicus* west of the Dakotas. It is possible, however, that additional collecting in eastern Colorado and Wyoming may fill the gap. As far as structure is concerned, *modoc* seems very closely related to *pennsylvanicus*. The principal difference appears to lie in the shorter abdominal pubescence of *modoc*.

6. Camponotus laevigatus (F. Smith)

Formica laevigatus F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 55 (1858) ♀ ♀.

C. laevigatus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 420 (1886) ♀ ♀; Emery, Zool. Jahrb. Syst., Vol. 7, p. 671 (1893); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 327 (1910) ♀ ♀ ♂.

Type loc: California. Types: British Museum.
Range: Pacific Coast States east to the Rocky Mountains.

7. Camponotus noveboracensis (Fitch)

Formica noveboracensis Fitch, Trans. N. Y. State Agri. Soc., Vol. 14, p. 52 (1845) ♀.

C. herculeanus subsp. *ligniperda* var. *pictus* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 59 (1879) ♀ ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 7, p. 674 (1893).

C. herculeanus subsp. *ligniperda* var. *noveboracensis* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 340 (1910) ♀ ♀ ♂.

C. herculeanus subsp. *ligniperda* var. *rubens* Wheeler, Psyche, Vol. 13, p. 41 (1906) ♀ ♂; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 341 (1910) ♀ ♂.

Type loc: none given, by inference the State of New York. Types: none known to exist.

Range: coast to coast, mainly in latitudes between 40° and 48°.

The taxonomic history of this insect has been singularly unfortunate. Fitch's description was overlooked by European specialists with the result that for many years the insect was known by Forel's name *pictus*. At that time Forel had reduced *ligniperda* to a subspecies of *herculeanus*. Since Forel attached *pictus* to *ligniperda*, it became a variety of *herculeanus*. But when *ligniperda* was finally restored to full specific status, *pictus* was allowed to remain as a variety of *herculeanus*. By this time *pictus* had been recognized as a synonym of *noveboracensis*. But while the change of names has been widely sanctioned, no one has seen fit to question the propriety of including *noveboracensis* as an infraspecific variant of *herculeanus*. Actually the two insects show rather superficial similarities. In both the thorax of the female is more strongly shining than is usually the case in this subgenus. In both the thorax of the worker is more or less marked by a red color. But against these common characters may be set differences of much greater consequence. The antennal scapes of *noveboracensis* are notably longer than those of *herculeanus*. In the major worker of *noveboracensis* the scapes surpass the occipital angles by an amount about three times as great as their maximum diameter. In addition the abdominal pubescence of *noveboracensis* is extremely fine and very dilute, so that the shining surface of the gaster is clearly apparent. In *herculeanus* the gastric pubescence is notably heavier and the surface of the gaster is dull, except for a feebly shining band at the rear of each segment. I do not believe that these two insects intergrade, despite the fact that Wheeler described specimens from the state of Washington as intergrades between *noveboracensis* and *herculeanus*. As far as proximity is concerned, there is no reason why the two should not intergrade, for the southern end of the range of *herculeanus* overlaps that of *noveboracensis* in both the eastern and western states. It seems to me that the lack of intergrades in such areas furnishes a further proof that the two are separate species. Finally, I have found it necessary to synonymize Wheeler's variety *rubens* with *noveboracensis*. This form was described from a very few old and faded specimens. As no fresh specimens showing the coloration of *rubens* have ever been recorded it may be doubted that it is even a nest variety. The distributional data prove conclusively that it cannot be a geographical race.

8. Camponotus schaefferi Wheeler

C. schaefferi Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 89 (1909) ♀ ♀ ; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 344 (1910) ♀ .

Type loc: Cochise Co., Arizona. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: mountains of southern Arizona, where it nests under logs at elevations of about 5000 feet.

There are a number of points in the original description of *schaefferi* which are very confusing. The cotypes in my collection show no trace of transverse impression on the cheeks of the major. The sides of the head throughout most of their length are very slightly convex, although they curve inward suddenly near the insertion of the mandibles. The clypeus is neither flat nor is its anterior border distinctly excised in the middle. Instead, it is moderately convex with the middle of the anterior border straight. The scapes of the major extend beyond the occipital corners by at least ⅓ their length. The frontal area is by no means indistinct and the V-shaped notch in the rear border of the clypeus, which lies just anterior to the frontal area, is very pronounced. The color and pilosity of this insect were accurately described. I have transferred this species to the subgenus Camponotus since the structure of the clypeus is more like that of Camponotus than Myrmentoma. When this insect and *texanus* are better known it may be necessary to erect a separate subgenus for them.

9. Camponotus texanus Wheeler

C. texanus Wheeler, Psyche, Vol. 10, p. 108, fig. 10 (1903) ♀ ♀ ♂; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 344 (1910) ♀ .

Type loc: Travis County, Texas. Types: A.M.N.H., M.C.Z.

Range: central Texas in the region between Austin and San Antonio.

This species, like *schaefferi*, has a clypeal structure which is more like that of Camponotus than Myrmentoma. In addition, its large size would make it exceptional in the latter subgenus.

Subgenus Tanaemyrmex Ashmead

There have been so many revisionary changes in the case of species assigned to this subgenus that it seems advisable to present a summary of the arrangement followed in this work. Before giving this list I wish to explain why such extensive revision was necessary. I have already discussed the reasons for shifting to Tanaemyrmex several species which Emery assigned to the subgenus Camponotus (see

discussion at the beginning of Camponotus) but while this shift confers distinct advantages in the matter of better subgeneric delimitation, it does nothing towards solving the difficulties of the tangle of variants which has grown up around the species *sansabeanus*. Originally the *sansabeanus* complex was treated as a part of the even more formidable *maculatus* assemblage. The need for specific recognition within this fantastically intricate maze resulted in the splitting off of a number of species. One of these was *sansabeanus*. But with *sansabeanus* removed from the specific limits of *maculatus*, the revisionary work on this highly confused tangle of variants largely ceased. Yet further revision is urgently needed.

I have no wish to appear unduly harsh towards earlier work done on this very difficult complex but any careful examination of this work will bring the conviction that there has been too much stress laid on minor color variations and not enough attention paid to major structural differences or to geographical data. The practice of naming very slight color differences from inadequate series of specimens is to be regretted. Wheeler's variety *luteangulus* is an example of this practice. The type series of this variety consisted of about a dozen stray workers taken at four widely separated stations. It was, therefore, impossible to evaluate the constancy of the light colored blotches on the occipital corners of the major which supposedly distinguish this form. There is, unfortunately, no constancy in this character. At a conservative estimate more than fifty percent of all the members assigned to the *sansabeanus* complex will, at times, show such blotches. Hence *luteangulus* is not only unrecognizable but, what is worse, may be recognized in many nest series whose more significant characteristics clearly show them to be some other form. A number of the color variants previously assigned to *sansabeanus* show this same lack of constancy but this is by no means the worst feature involved. A much more serious situation arises from the fact that many of them have coincidental ranges. It may be admitted that in recent years the concepts concerning the distribution of subspecies have become much more stringent. Because of this, the older infraspecific groupings seldom meet modern requirements. Even so, it is seldom that myrmecologists have elected to set up such a bewildering conglomeration of spatially coincidental subspecies and varieties as one finds in the *sansabeanus* complex. With the possible exception of the typical *sansabeanus*, there is not another variant in the complex which occupies a range to itself. Frequently three or four variants will occur together over large areas.

It is obvious that drastic steps are necessary to correct this situation and it is equally obvious that such steps must involve consid-

erable synonymization. The first step towards a solution was taken by Wheeler in 1917, when he recognized *ocreatus* as a separate species. I believe that it is necessary to accord specific status to *vicinus* and *maccooki* as well. The major part of the extensive synonymization has occurred in the case of color varieties previously assigned to *vicinus*. The arrangement used in this work is as follows:

1. *C.* (*Tanaemyrmex*) *acutirostris* Wheeler
   = var. *clarigaster* Wheeler
2. " " *castaneus* Latreille
3. " " *fumidus* subsp. *festinatus* Buckley
   = subsp. *spurcus* Wheeler
4. " " *incensus* Wheeler
5. " " *maccooki* Forel
   = var. *semitestacea* Emery
   = var. *berkeleyensis* Forel
   = subsp. *dumetorum* Wheeler
6. " " *ocreatus* Emery
   = subsp. *primipilaris* Wheeler
7. " " *sansabeanus* Buckley
8. " " *sansabeanus* subsp. *bulimosus* Wheeler
9. " " *sansabeanus* subsp. *torrefactus* Wheeler
10. " " *socius* Roger
    = var. *osceola* Wheeler
11. " " *tortuganus* Emery
12. " " *vafer* Wheeler
13. " " *vicinus* Mayr
    = var. *infernalis* Wheeler
    = var. *luteangulus* Wheeler
    = var. *maritimus* Wheeler
    = var. *nitidiventris* Emery
    = var. *plorabilis* Wheeler
    = var. *subrostratus* Forel

The variant of *fumidus* which Pergande named *fragilis* does not appear in the above list. Wheeler was of the opinion that he had taken this insect in Texas but it seems clear from Wheeler's own data that what he had was the subspecies *festinatus*. I have never seen any specimens from the United States that could be assigned to *fragilis* and the fact that the types came from San Jose del Cabo and San Fernando in Lower California, argues against its occurrence within our borders.

The habits of the ants of the subgenus Tanaemyrmex are rather uniform. Most of the species nest in dry, gravelly soil. The nests are

usually constructed under a covering stone but at times they may be surmounted by a low crater of earth. These ants rarely nest in wood and when they do the nest is usually buried under the soil. This proved to be the case with *socius*, an introduced species which has become widely spread in the eastern Gulf States and Florida. For several years I was unable to discover where this strikingly beautiful species nests, but ultimately found that the nests were built in branches and small rotten logs which had been entirely covered over by sand. I have never found them nesting in any other situation.

Key to the species of Tanaemyrmex

1. Antennal scapes with numerous, fine, short, erect hairs 2
   Antennal scapes without erect hairs except for a cluster at the tip 3
2. Anterior border of the clypeus broadly and feebly excised; erect hairs on the gula short and all of about the same length; mandibles with 5–6 teeth; length of the major 12–14 mm. ..... *vafer*
   Anterior border of the clypeus entire; erect hairs on the gula uneven in length, some of them long; mandibles with seven teeth; length of the major 8–10 mm. ..... *fumidus* subsp. *festinatus*
3. Middle and hind tibiae with a row of graduated, erect bristles on their flexor surfaces 5
   Middle and hind tibiae without such bristles 4
4. Head and thorax subopaque; length of the major 10–11 mm. .. *tortuganus*
   The posterior corners of the head and the entire thorax feebly shining; length of the major 7 mm. ..... *incensus*
5. Scapes of the major surpassing the occipital corners by an amount equal to or greater than the length of the first funicular joint 6
   Scapes of the major not surpassing the occipital corners, or surpassing them by an amount less than the length of the first funicular joint ... 11
6. Scape of the major distinctly flattened at the base and with the flattened portion forming a small lateral lobule ..... *maccooki*
   Scape of the major not flattened at the base or, if flattened, there is no lateral lobule 7
7. The occipital corners covered with numerous, erect hairs; gaster completely opaque ..... *socius*
   The occipital corners without erect hairs; gaster feebly to strongly shining 8
8. Cheeks strongly shining with very small, inconspicuous punctures 9
   Cheeks feebly shining or dull, the punctures coarser and conspicuous .. 10
9. Thorax and gaster as strongly shining as the cheeks; color uniform castaneous brown ..... *castaneus*
   Thorax and gaster less strongly shining than the cheeks; head black, thorax and gaster ochreous yellow, often suffused with brown, tibiae and tarsi brown to black ..... *ocreatus*

10. Scapes of the major flattened at the base; cheeks without erect hairs.... *vicinus*
Scapes of the major not flattened at the base; cheeks with erect hairs... *acutirostris*
11. Scapes of the major flattened and lobulate at the base.....12
Scapes of the major flattened at the base but not lobulate..... *sansabeanus* subsp. *torrefactus*
12. Head reddish brown, thorax and gaster light, brownish yellow . *sansabeanus*
Head black, thorax and gaster blackish or brownish red..... *sansabeanus* subsp. *bulimosus*

10. Camponotus (Tanaemyrmex) acutirostris Wheeler

C. acutirostris Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 317 (1910) ♀ ♀ ♂.
C. acutirostris var. *clarigaster* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 420 (1915) ♀.
Type loc: Alamogordo, New Mexico. Types: M.C.Z., A.M.N.H.
Range: low elevations in mountain canyons in New Mexico and Arizona.

The variety *clarigaster*, which was described from a single specimen, was based upon extremely slight differences of color. There is, of course, no possibility of determining its validity under such circumstances and it is best treated as a synonym of the typical form.

11. Camponotus (Tanaemyrmex) castaneus (Latreille)

Formica castaneus Latreille, Fourmis, p. 118, pl. 3, figs. 11, 12, A,C,D (1802) ♀ ♀ ♂.
Formica mellea Say, Bost. Jour. Nat. Hist., Vol. 1, p. 286 (1836) ♂.
C. castaneus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 420 (1886); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 321 (1910) ♀ ♀ ♂.
C. melleus Mayr, Sitz. Akad. Wiss. Wien, Vol. 53, p. 485 (1866); Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 60 (1879) ♀ ♀ ♂.
Type loc: Carolina and Pennsylvania. Types: none in this country.
Range: southern New England to the Gulf States. The western boundary of the range extends from Iowa to eastern Texas.

Despite its long association with the subgenus Camponotus, there are sound reasons for transferring *castaneus* to the subgenus Tanaemyrmex. These have been obscured by the fact that *americanus* has been treated as a subspecies of *castaneus*. As I have explained elsewhere, the two insects have little in common. The head of the major worker of *castaneus* shows the distinct median incision of the clypeal border which is found in the species belonging to Tanaemyrmex. The

head of the major is notably longer than broad. The clypeus is distinctly carinate. Indeed, the only thing at all out of line with this treatment is the range of *castaneus*. It must be admitted that its presence in the northeastern United States is exceptional for a member of the subgenus Tanaemyrmex. I believe, however, that it is better to accept this than to attempt to force *castaneus* into the subgenus Camponotus. To do so destroys any chance of securing a good separation between that subgenus and Tanaemyrmex.

12. Camponotus (Tanaemyrmex) fumidus festinatus (Buckley)

Formica festinatus Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 164 (1866) ☿ ♀.
C. fumidus var. *festinatus* Wheeler, Trans. Tex. Acad. Sci., Vol. 4 (2), p. 22 (1902); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 312 (1910) ☿ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 604, pl. 18, fig. 68 (1947) ☿.
C. fumidus var. *pubicornis* Emery, Zool. Jahrb. Syst., Vol. 7, p. 670 (1893) ☿.
C. fumidus var. *spurcus* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 315 (1910) ☿ ♀.
Type loc: central Texas. Types: none known to exist.
Range: central Texas to southern Arizona and south into Mexico.

I am unable to see why Wheeler set up the variety *spurcus*. As he himself noted, the subspecies *festinatus* is highly variable in coloration and he felt that additional material would show that the two are connected by "numerous transitional forms". This certainly seems to be the case. In my opinion the specimens from the western end of the range of *festinatus* are fully as light and as variable in coloration as are those from Texas. I have taken many colonies of this insect both in Texas and in the mountains of southern Arizona and I can detect no difference which would justify the recognition of a western race.

13. Camponotus (Tanaemyrmex) incensus Wheeler

C. (Tanaemyrmex) incensus Wheeler, Jour. N. Y. Ent. Soc., Vol. 40, p. 14 (1932) ☿.
Type loc: Pigeon Key (Miami), Florida. Types: M.C.Z.
Range: known only from type material.

It seems impossible to state at present exactly what this form represents. It was described from three specimens (one 'major' and two minors) and this gives a very inadequate picture of the insect. It

may possibly be a synonym of *tortuganus*, which it strongly resembles. Indeed, the main difference between the two appears to be the smaller size of the major in *incensus*. It is impossible to decide, from the wholly inadequate type series, what the full size of the major of *incensus* is. Additional collecting in the Miami area may throw more light on this enigmatical form.

14. Camponotus (Tanaemyrmex) maccooki Forel

C. sylvaticus subsp. *maccooki* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 69 (1879) ♀ ♀ ♂.
C. maculatus subsp. *maccooki* Emery, Zool. Jahrb. Syst., Vol. 7, p. 672 (1893); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 306 (1910) ♀ ♀ ♂.
C. maculatus subsp. *vicinus* var. *semitestacea* Emery, Zool. Jahrb. Syst., Vol. 7, p. 672 (1893) ♀ ; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 304 (1910) ♀ .
C. maculatus subsp. *dumetorum* Wheeler, Ibid., Vol. 20, p. 354 (1910) ♀ ♂.
C. maculatus subsp. *maccooki* var. *berkeleyensis* Forel, Deutsche Ent. Zeitschr., p. 619 (1914) ♀ .
Type loc: Guadalupe Island, Lower California. Types: A.M.N.H.
Range: Washington and Oregon south through California into Lower California. The insect is abundant only in the southern half of this range.

There appears to have been considerable confusion concerning the differences which supposedly separate *semitestacea* and *maccooki*. When Emery described *semitestacea* he possessed only two workers. At this time he had a single worker media cotype of *maccooki* for comparison. It is significant that Emery noted that both *maccooki* and *semitestacea* possess lateral lobes at the base of the antennal scapes. The separation which Emery used depended mainly on the fact that in *maccooki* the posterior part of the head was slightly more shining than in *semitestacea*. Wheeler, who mistakenly inferred that *semitestacea* lacked the antennal lobe, did not see any authentic material of this insect until after he had monographed our species of Camponotus. As a result he placed *semitestacea* with those forms which lack the antennal lobe and his key is highly misleading in this particular. Actually the only differences which separate *semitestacea* and *maccooki* are very slight distinctions of cephalic sculpture and color. I cannot see that either of these differences is sufficiently constant to permit successful separation. I am also of the opinion that *maccooki* has been described under different names by Wheeler and Forel. The characteristics on which Wheeler set up the subspecies *dumetorum* seem to be well within the range of variation shown by *maccooki* and, as Wheeler pointed out, Forel's *berkeleyensis* is a synonym of *dumetorum*. Until we know more

about the distribution of *maccooki* in northern California, it seems preferable to treat all three variants as synonyms of the typical *maccooki*.

15. Camponotus (Tanaemyrmex) ocreatus Emery

C. maculatus subsp. *ocreatus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 637 (1893) ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 309 (1910) ♀.

C. ocreatus Wheeler, Proc. Amer. Acad. Arts. Sci. Boston, Vol. 52, p. 561 (1917).

C. acutirostris subsp. *primipilaris* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 319 (1910) ♀.

C. ocreatus subsp. *primipilaris* Wheeler, Proc. Amer. Acad. Arts. Sci. Boston, Vol. 52, p. 562 (1917).

Type loc: Panamint Mountains, California. Types: U.S.N.M., M.C.Z., A.M.N.H.

Range: a discontinuous distribution in the mountains of southern California, Arizona and New Mexico.

The characteristics which mark *ocreatus* are very distinct and it is unfortunate that Wheeler was not better acquainted with this species when he monographed Camponotus in 1910. At that time Wheeler failed to recognize the worker of *ocreatus* as such, but he redescribed it as a subspecies of *acutirostris* (*primipilaris*). Later Wheeler discovered type specimens of *ocreatus* and attempted to rectify his former error by transferring *primipilaris* to *ocreatus*. These two insects are so nearly the same that there is no justification for Wheeler's treatment. He should have made *primipilaris* a synonym of *ocreatus*. I believe that little significance can be attached to the clypeal structure of *ocreatus*, although Wheeler consistently cited this as an important separatory character. Although some major workers of *ocreatus* have an obtuse, triangular lobe at the middle of the anterior margin of the clypeus, this character never seems to hold over a nest series. There are much more constant features by which *ocreatus* may be recognized. The head of the major of *ocreatus* is notably narrowed in front of the eyes. The scapes surpass the occipital corners by an amount approximately equal to the length of the first two funicular joints combined. The scapes show no trace of basal flattening. The cheeks are strongly shining. None of these characters would serve to distinguish *ocreatus* if taken alone, but the combination of them is unique.

16. Camponotus (Tanaemyrmex) sansabeanus (Buckley)

Formica sansabeana Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 167 (1866) ♀ ♀ ♂.

C. maculatus subsp. *maccooki* var. *sansabeanus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 672 (1893) ♀ ♀.

C. maculatus subsp. *sansabeanus* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 307 (1910) ♀ ♀ ♂.
Type loc: Burnet and San Saba Counties, Texas. Types: none known to exist.
Range: central Texas to Arizona and southern Colorado.

17. Camponotus (Tanaemyrmex) sansabeanus bulimosus Wheeler

C. maculatus subsp. *bulimosus* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 308 (1910) ♀ ♂.
Type loc: Parmerlee and Huachuca Mountains, Arizona. Types: M.C.Z., A.M.N.H.
Range: mountains of southern Arizona at elevations between 5000 and 6000 feet.

18. Camponotus (Tanaemyrmex) sansabeanus torrefactus Wheeler

C. maculatus subsp. *sansabeanus* var. *torrefactus* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 308 (1910) ♀ ♂.
Type loc: Coconino Forest, Grand Canyon, Arizona. Types: M.C.Z.
Range: northern Arizona and southern Utah.

19. Camponotus (Tanaemyrmex) socius Roger

C. socius Roger, Berl. Ent. Zeitschr., Vol. 7, p. 140 (1863) ♀ ♀; Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 74 (1879) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 422 (1886) ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 319 (1910) ♀ ♀ ♂.
C. socius var. *osceola* Wheeler, Jour. N. Y. Ent. Soc., Vol. 40, p. 15 (1932) ♀.
Type loc. Brazil. Types: none in this country.
Range: Florida and the southern portions of Georgia, Alabama and Mississippi.

It is much to be regretted that Wheeler elected to describe the variety which he called *osceola*. The type series of *osceola* consisted of four specimens in which the red color of the head and thorax is paler and the gastric dorsum more yellow than is usual. While it may seem difficult to credit the idea that Wheeler described the color pattern of recently emerged workers, this appears to be the correct explanation. When *osceola* was described the material of *socius* present in the Museum of Comparative Zoölogy consisted of a considerable number of individuals taken singly or in very small series from a num-

ber of localities. All the evidence points to the assumption that these workers were taken while foraging. At least it can be stated with certainty that if any of them were taken from a nest, only a fraction of the colony was secured. In the few nests of *socius* which I have found there have always been some paler workers whose coloration corresponds to that of *osceola*. Such individuals are well past the callow stage but they are not fully colored and do not voluntarily leave the nest. Hence they would not be present in a collection of workers taken while foraging. One may assume that the four specimens from which *osceola* was described were turned up by some accident to the nest. But to attribute nomenclatorial distinction to this immature color phase of *socius* is, in my opinion, impossible.

One further point in connection with *socius* may be considered here. Its status as a member of our ant fauna presents an engaging problem to those interested in distributional phenomena. The original description of *socius* was based on specimens taken in Brazil and it was not until some years later that the presence of this insect in the southeastern United States was recognized. Since the species is absent in Mexico, Central America, northern South America and the Antilles, it is virtually certain that introduction has played a part in this unusual distribution. The difficulty is to decide which of the two populations is native and which is immigrant. It is generally assumed that the Brazilian population is the native stock but this is not easy to prove. At present *socius* is evenly distributed over most of Florida and the southern portions of Georgia, Alabama and Mississippi. As it is nowhere very abundant, there is nothing in its distribution in the United States to indicate that it is behaving as an introduced species. The same situation seems to be true of the Brazilian population. If *socius* has been introduced into the United States, it is now so at home in its new environment that it shows the characteristics of a native species.

20. Camponotus (Tanaemyrmex) tortuganus Emery

C. maculatus subsp. *tortuganus* Emery, Zool. Jahrb. Syst., Vol. 8, p. 336 (1895) ♀ ; Wheeler, Ann. N. Y. Acad. Sci., p. 310 (1910) ♀ ♀ ♂.
Type loc: Dry Tortugas, Florida. Types: none in this country.
Range: southern Florida through the Keys to the Tortugas.

I have followed Wheeler in treating *tortuganus* as a separate species. The insect certainly cannot be assigned to *maculatus* and Emery's attempt to shift it to the species *conspicuus* was not satisfactory, even to him. The exact status of *tortuganus* will remain problematical until a thorough study of the Neotropical representatives of Tanaemyrmex is made.

21. Camponotus (Tanaemyrmex) vafer Wheeler

C. vafer Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 315 (1910) ♀ ♀.
Type loc: Huachuca Mountains, Arizona. Types: M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.

22. Camponotus (Tanaemyrmex) vicinus Mayr

C. vicinus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 940 (1870) ♀; Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 16, p. 60 (1879).
C. maculatus subsp. *vicinus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 671 (1893) ♀ ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 301 (1910) ♀ ♀ ♂.
C. maculatus subsp. *vicinus* var. *nitidiventris* Emery, Zool. Jahrb. Syst., Vol. 7, p. 672 (1893) ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 304(1910) ♀ ♂.
C. maculatus subsp. *vicinus* var. *infernalis* Wheeler, Ibid., Vol. 20, p. 305 (1910) ♀ ♂.
C. maculatus subsp. *vicinus* var. *luteangulus* Wheeler, Ibid., Vol. 20, p. 304 (1910) ♀ ♂.
C. maculatus subsp. *vicinus* var. *maritimus* Wheeler, Ibid., Vol. 20, p. 305 (1910) ♀ ♀ ♂.
C. maculatus subsp. *vicinus* var. *plorabilis* Wheeler, Ibid., Vol. 20, p. 303 (1910) ♀ ♀ ♂.
C. maculatus subsp. *vicinus* var. *subrostratus* Forel, Deutsche Ent. Zeitschr., p. 620 (1914) ♀.
Type loc: California (by present restriction). Types: none in this country.
Range: the Rocky Mountains west to the Pacific, from British Columbia south into the highlands of Mexico.

I have restricted the type locality of this species to California. In his original description of *vicinus*, Mayr used a mixed type series, only a part of which came from that state. Other specimens were taken in Connecticut, Virginia and New Mexico. The first two of these records are obviously incorrect. Wheeler was aware of this difficulty when he monographed Camponotus in 1910. Wheeler called attention to Mayr's error but made no attempt to restrict the type series of *vicinus*. It seems to me that it is imperative that this restriction be made. Otherwise the status of *vicinus* is jeopardized by the existence of type specimens which have nothing to do with the species.

It seems unnecessary to discuss in detail the several varieties which have been placed in the synonymy of *vicinus*, for all but one of them can be covered by the same general statement. The color and pubescence of *vicinus* will vary over its entire range but there appears to be no correlation whatever between these variations and distribution. For this reason there are always two or more of them present in the same area. It is certain that these differences are not of subspe-

cific significance. These differences are too inconsequential and variable to be regarded as specific characters. The only possibility is to treat them as synonyms. In the case of the variety *subrostratus,* Forel has presented a description of the clypeus which strongly suggests that the insect is *ocreatus.* His brief description fails to mention any character which might confirm this surmise and there seems to be no way at present of determining the exact character of *subrostratus.* Since the variety was described from medias and minor workers, it may never be possible to arrive at a satisfactory treatment for it. I believe that it will save confusion if *subrostratus* is placed in the synonymy of *vicinus* until it can be shown that this is incorrect.

Subgenus MYRMENTOMA Forel

Of all the subgenera of Camponotus present in North America none is more difficult than Myrmentoma. There are intrinsic difficulties in this subgenus which cannot be avoided, but its taxonomy has been needlessly complicated by Wheeler's inclusion of *texanus* and *schaefferi.* In my opinion neither of these species can properly be regarded as belonging to Myrmentoma. Their assignment to this subgenus has had the unfortunate effect of breaking down a clear-cut subgeneric diagnosis. It may be admitted that superficially the two species suggest a relationship to Myrmentoma, but neither possesses a clypeus with a deep, narrow, median notch, which is the distinguishing subgeneric characteristic of Myrmentoma. It is always difficult to know what to do with transitional forms of this sort but it is my belief that both *schaefferi* and *texanus* present fewer incongruities if allocated to the subgenus Camponotus. They have been so treated in the present work. In the future it may prove advisable to erect a separate subgenus to receive them.

With *texanus* and *schaefferi* removed from Myrmentoma, the subgenus shows a much greater structural homogeneity. Indeed this very fact appears to be the main difficulty in the case of the *caryae* complex. Because the members of this large assemblage show comparatively slight structural differences, it has been felt necessary to treat these differences as of no more than subspecific value. A sounder view of these distinctions might have been reached if Emery and Wheeler had been less concerned with giving names to varieties. When one encounters such varieties as Wheeler's *pardus, pavidus* and *tanquaryi,* each of which was described with the full knowledge that the definitive characters are highly variable, it is easy to secure the impression that a comparable situation marks all the members of the *caryae* complex. This is untrue. Most of the subspecies in this group

have been founded upon constant distinctions related to cephalic sculpture and pilosity. These differences are entirely apart from the fluctuating and inconsequential variations which mark most of the varieties. Emery recognized these differences as early as 1893 and in 1910 Wheeler utilized them to divide the *caryae* complex into two main groups. Yet neither Emery nor Wheeler ever considered the possibility that these differences might be of specific significance. In fact Wheeler appears to have lost sight of them. As Dr. M. R. Smith has shown, in 1917 Wheeler completely overlooked the characteristic cephalic sculpture and pilosity of Fitch's types of *caryae*. As a result he confused this insect with Emery's *nearcticus*. Dr. Smith's revisionary paper of 1940 has clearly demonstrated Wheeler's error. It has also shown that Emery's variety *cnemidatus* is a synonym of Fitch's *caryae*. But this is as far as the revision of the *caryae* complex has gone. Dr. Smith's studies on Myrmentoma, which he mentions in his 1940 paper, have remained unpublished. No one regrets this more keenly than the writer. The circumstance has forced upon me the task of trying to put the *caryae* complex on an acceptable basis. I have discussed this matter with Dr. Smith and I believe that we are in agreement on the main features of the plan outlined below. Although this plan may appear, at first sight, to be drastically different from the older concept of the *caryae* complex, it embodies the main organizational features of the older system. The differences arise from an attempt to distinguish valid criteria (those formerly used to delimit subspecies) from invalid ones (those formerly applied to varieties). The structural constancy and distributional behavior of the former subspecies leaves no room for doubt as to their status. They must be treated as species, not as subspecies. There is, however, no such certainty as to what should be done with the varieties. In consonance with the practice employed elsewhere in this volume I have treated them as synonyms unless it could be shown that the variety has a geographical significance. Most of them plainly do not. We must, I believe, recognize the fact that over most of the eastern half of the United States the species *nearcticus* produces a welter of color variations, any or all of which may occur in the same areas. There is not the slightest evidence to indicate that a single one of these variants has a range of its own and there is abundant evidence to show that they intergrade endlessly. Those who have a high regard for varietal names will find the synonymy of these variants distasteful. It should, however, produce one highly desirable result. Hereafter those who wish to use these varietal names can have no reason to complain of the difficulties which this practice involves. If they find these forms impossible of exact determination, if the keys which supposedly sep-

arate them fail to do so, then it may be recognized that these are the penalties which must be paid for pushing a nomenclatorial system too far. For the sake of convenience I have included in the list which follows the full representation of the subgenus Myrmentoma in North America.

1. *C.* (*Myrmentoma*) *anthrax* Wheeler
2. *C.* (*Myrmentoma*) *caryae* Fitch
   = var. *cnemidatus* Emery
3. " " *caryae* subsp. *discolor* Buckley
4. " " " subsp. *clarithorax* Emery
5. *C.* (*Myrmentoma*) *essigi* M. R. Smith
6. *C.* (*Myrmentoma*) *hyatti* Emery
7. " " " subsp. *bakeri* Wheeler
8. *C.* (*Myrmentoma*) *nearcticus* Emery
   = var. *decipiens* Emery
   = var. *minutus* Emery
   = var. *pardus* Wheeler
   = var. *pavidus* Wheeler
   = var. *tanquaryi* Wheeler
9. *C.* (*Myrmentoma*) *rasilis* Wheeler
10. *C.* (*Myrmentoma*) *sayi* Emery
11. *C.* (*Myrmentoma*) *subbarbatus* Emery
    = var. *paucipilis* Emery ?

The forms may be separated by means of the following key:

Key to the species of Myrmentoma

1. Mesoepinotal suture of the major and larger workers distinctly impressed, the impression broad and involving the rear of the mesonotum and the front of the epinotum 2
   Mesoepinotal suture of the major and larger workers unimpressed or, if a slight impression is present, it consists of a narrow, shallow, transverse groove on the dorsum of the epinotum immediately behind the suture .. 3
2. Gaster entirely black or dark brown ..... *hyatti*
   Basal two-thirds of the first gastric segment red ..... *hyatti* subsp. *bakeri*
3. Antennal scapes of the major not surpassing the posterior corners of the head 4
   Antennal scapes of the major surpassing the posterior corners of the head by an amount at least as great as the greatest thickness of the scape ... 5
4. Color black, front of the head and the mandibles dingy red; the gaster coarsely shagreened and bearing conspicuous punctures; mandibles usually with 6 teeth ..... *anthrax*
   Head and thorax yellowish red, only the gaster black; the latter finely shagreened with fine, piligerous punctures; mandibles with 4–5 teeth .. *sayi*

5. The majors and larger workers with numerous, short, erect hairs arising from coarse, oval foveolae on the cheeks.....6
   The foveolae on the cheeks of the majors and larger workers small and hairless.....9
6. Erect hairs on the cheeks and clypeus all of approximately the same length and of equal abundance.....7
   Erect hairs on the clypeus notably longer and a little less abundant than those on the cheeks.....*subbarbatus*
7. Head, thorax and gaster uniform piceous black.....*caryae*
   Head and thorax brownish red to reddish yellow, color of gaster variable but at least a part of it darker than the thorax.....8
8. Head and thorax clear brownish red, gaster uniform piceous black.....
   caryae subsp. *discolor*
   Head and gaster brown, the latter sometimes with yellow basal markings, thorax yellow, paler than the head and gaster...*caryae* subsp. *clarithorax*
9. Frontal lobes rather strongly shining, their sculpture consisting largely of punctures, the shagreening very feeble; sides of the head in the major strongly convex and notably narrowed at the level of the mandibles..*essigi*
   Frontal lobes feebly shining to opaque, distinctly shagreened in addition to the punctures; sides of the head in the major at most moderately convex and not unusually narrowed at the level of the mandibles.....10
10. Clypeus distinctly broader than long in the majors and larger workers; middle of the occipital border in the major straight or feebly concave, the occipital lobes not pronounced; color highly variable.....*nearcticus*
    Clypeus only slightly broader than long in the majors and larger workers; middle of the occipital border in the major distinctly concave, the occipital lobes well marked; head and thorax clear yellowish red, the gaster piceous *rasilis*

23. Camponotus (Myrmentoma) anthrax Wheeler

C. anthrax Wheeler, Jour. N. Y. Ent. Soc., Vol. 19, p. 96 (1911) ♀ ♀ ♂.
Type loc: Santa Inez Mountains, Santa Barbara, California.
Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.

The only data on the nesting habits of this species appears to be that which Wheeler published at the time of its original description. Wheeler took five nests of *anthrax* each of which was constructed in soil under large stones. If this type of nest is customarily built by *anthrax*, its habits certainly differ from those of most of the other species in this subgenus.

24. Camponotus (Myrmentoma) caryae (Fitch)

Formica caryae Fitch, Trans. N. Y. State Agr. Soc., Vol. 14, p. 885 (1855) ♀ ♀ ♂.
C. (*M.*) *caryae* M. R. Smith, Proc. Ent. Soc. Wash., Vol. 42, No. 7, p. 139, figs. 1, 2 (1940) ♀ ♂.

C. marginatus subsp. *discolor* var. *cnemidatus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 678 (1893) ♀.
C. fallax subsp. *discolor* var. *cnemidatus* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 232 (1910) ♀.
Type loc: Salem, Washington County, New York. Types: U.S.N.M.
Range: eastern New York south to the District of Columbia and west to Ohio.

This insect appears to be rare. Dr. Smith makes no mention of other specimens beside the types of Fitch and Emery and the writer has seen no material belonging to it. Despite the paucity of records there would seem to be no reason why *caryae* may not be considered an eastern race, with *discolor* and *clarithorax* representing central and western races of the same species. I believe that I am correct in stating that Fitch cited no locality at the time when he described *caryae*. It may be presumed that Dr. Smith secured this information from the locality labels of the type series. This insect appears to be associated with hickory trees.

25. Camponotus (Myrmentoma) caryae discolor (Buckley)

Formica discolor Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 166 (1866) ♀ ♀.
C. marginatus subsp. *discolor* Emery, Zool. Jahrb. Syst., Vol. 7, p. 677 (1893) ♀ ♀ ♂.
C. fallax subsp. *discolor* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 330 (1910) ♀ ♀ ♂.
Type loc: Central Texas. Types: none known to exist.
Range: southern Alabama west to Texas and northward through the Mississippi Valley to Iowa, Illinois and southern Ohio.

The writer has found this subspecies to be abundant in southern Alabama and it seems virtually certain that it must occur in northwestern Florida. I have also seen specimens which Dr. Smith secured at Clemson College, South Carolina, so it seems probable that it also occurs sporadically both in that state and Georgia. These eastern records would, however, seem to lie outside the main range.

26. Camponotus (Myrmentoma) caryae clarithorax Emery

C. marginatus var. *clarithorax* Emery, Zool. Jahrb. Syst., Vol. 7, p. 678 (1893) ♀ ♀ ♂.
C. fallax subsp. *discolor* var. *clarithorax* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 231 (1910) ♀ ♀ ♂.
Type loc: Los Angeles, California. Types: A.M.N.H., M.C.Z., U.S.N.M., Coll. W. S. Creighton.
Range: known only from southern California.

Wheeler has recorded this insect from Pennsylvania and Illinois but these records are almost certainly incorrect. Wheeler himself seems to have doubted them. Emery was of the opinion that the hairs and punctures on the anterior part of the head of *clarithorax* are less numerous than those of *discolor*. I have been unable to note much difference in the types of *clarithorax* which I have examined. The main difference between the two forms appears to be one of color and, since the color of *clarithorax* is not particularly constant, it is by no means certain that *clarithorax* ought to be considered as a valid race. There is also the rather disconcerting fact that the range of *clarithorax* is widely separated from the western end of the range of *discolor*. It seems preferable, however, to treat *clarithorax* as a subspecies of *caryae* for it certainly shows no differences which would justify specific status.

27. Camponotus (Myrmentoma) essigi M. R. Smith

C. caryae subsp. *essigi* M. R. Smith, Ent. News, Vol. 34, p. 306 (1923) ♀ ♀.
Type loc: Lagunitas, California. Types: Coll. M. R. Smith, M.C.Z.
Range: coastal area of central California.

In the shape of the head the largest workers of this species strongly suggest those of *anthrax*. The head is very much narrowed at the level of the mandibles, with the result that the sides appear to be strongly convex. The scapes of *essigi* are, however, much longer than those of *anthrax* and the sculpture of *essigi* is feebler throughout. Mallis (1941) reports that he took this insect foraging in the debris at the edge of a salt marsh.

28. Camponotus (Myrmentoma) hyatti Emery

C. hyatti Emery, Zool. Jahrb. Syst., Vol. 7, p. 680, pl. 22, figs. 25, 26 (1893) ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 345 (1910) ♀.
Type loc: San Jacinto, California. Types: A.M.N.H., M.C.Z., U.S.N.M.
Range: central California.

29. Camponotus (Myrmentoma) hyatti bakeri Wheeler

C. hyatti subsp. *bakeri* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 271 (1904) ♀ ♀; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 346 (1910) ♀ ♀.
Type loc: Catalina Island, California. Types: A.M.N.H.
Range: known from type material only.

Wheeler evidently regarded *bakeri* as an insular variant of the typical *hyatti* and he may be right. There seems to be no way at present to evaluate the status of *bakeri*. It was described from four specimens (two females and two media workers) and these appear to have been the only representatives of this form that have ever been secured. I have retained *bakeri* as a subspecies but I doubt that it will prove to be valid. Other 'insular subspecies' which Wheeler described from Catalina Island have since proven identical with the mainland form.

30. Camponotus (Myrmentoma) nearcticus Emery

C. marginatus var. *nearcticus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 675 (1893) ♀ ♀.
C. fallax var. *nearcticus* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 222 (1910) ♀ ♀ ♂.
C. (*M.*) *caryae* subsp. *nearcticus* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 604, pl. 18, fig. 70 (1947) ♀.
C. caryae Wheeler, Psyche, Vol. 24, p. 27 (1917) (*nec* Fitch).
C. marginatus var. *decipiens* Emery, Zool. Jahrb. Syst., Vol. 7, p. 676(1893) ♀ ♀.
C. fallax var. *decipiens* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 227 (1910) ♀ ♀ ♂.
C. marginatus var. *minutus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 676 (1893) ♀ ♀ ♂.
C. fallax var. *minutus* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 224 (1910) ♀ ♀ ♂.
C. fallax var. *pardus* Wheeler, Ibidem, p. 225 (1910) ♀ ♀ ♂.
C. fallax var. *tanquaryi* Wheeler, Ibidem, p. 226 (1910) ♀ ♀ ♂.
C. fallax rasilis var. *pavidus* Wheeler, Ibidem, p. 228 (1910) ♀ ♀.
Type loc: Pennsylvania (by present restriction). Types: none in this country.
Range: New England south to Florida and southwest to Texas. In the northern states the range terminates in the Dakotas but resumes again in the Pacific Northwest. There the insect occurs from British Columbia south to California with an eastward extension reaching Idaho.

It seems scarcely necessary to present a detailed account of the reasons for synonymizing the varieties *pardus*, *tanquaryi* and *pavidus*. The unsatisfactory status of these varieties was apparent in the original descriptions which Wheeler presented in 1910. Each is based upon a slight distinction of color. Each is admittedly transitional in this respect. In each the definitive color characteristic was known to vary in the type series. In my opinion no one of the three should ever have been named. The situation with Emery's variety *decipiens* is somewhat different. In 1941 Wheeler showed that *decipiens* had been based upon a mixed type series. The Texas types Wheeler considered iden-

tical with his *rasilis*, hence to avoid Emery's prior name Wheeler restricted *decipiens* to the Indiana types. In so doing he destroyed the principal distinction on which the recognition of *decipiens* rested. Although Wheeler continued to recognize *decipiens*, it is clear that the color characters which he employed will not allow a satisfactory separation of this insect from *nearcticus*. Finally there is the variety *minutus*. Our younger myrmecologists have had little trouble with this variant for an excellent reason. They have with commendable uniformity let it severely alone. No other course is practical, since it is now clear that neither the size differences nor the coloration which Emery used to distinguish *minutus* can be relied upon. It seems clear enough that Emery's original delimitation of *minutus* was the result of a lack of adequate material but this will not excuse Wheeler's subsequent handling of the form. Although Wheeler was clearly aware that no color distinction was possible in the case of *minutus*, and although he showed that there was no difference in the size of the male and too little in the size of the female and worker to give good separation, he continued to defend this variety as a 'paler and depauperate form' of *nearcticus!* There is no wonder that our students of ants have despaired of recognizing this insect.

31. Camponotus (Myrmentoma) rasilis Wheeler

C. fallax subsp. *rasilis* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 227 (1910) ♀ ♀ ♂.

Type loc: Austin, Texas (by present restriction). Types: A.M.N.H., M.C.Z.

Range: Gulf Coast States from Florida to Texas and sporadically westward to southern Arizona. The northern limit of the range of *rasilis* is difficult to determine. It is abundant in the states bordering the Gulf of Mexico, but the incidence decreases rapidly to the north. The northern limit of the range appears to lie near Lat. 35° in the eastern and central states.

32. Camponotus (Myrmentoma) sayi Emery

C. sayi Emery, Zool. Jahrb. Syst., Vol. 7, p. 679 (1893) ♀; Wheeler, N. Y. Acad. Sci., Vol. 20, p. 343 (1910) ♀.

Type loc: Phoenix, Arizona. Types: A.M.N.H., M.C.Z.

Range: central Arizona.

G. C. and E. W. Wheeler have reported this species from the badlands of North Dakota (1944) but the record is scarcely credible. We know little enough about the distribution of *sayi* but what we do know

indicates clearly that the insect does not occur north of Arizona. Despite much collecting it has never been taken in Utah or Colorado. That it should appear in western North Dakota seems absolutely impossible.

33. Camponotus (Myrmentoma) subbarbatus Emery

C. marginatus subsp. *subbarbatus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 676 (1893) ♀ ♀ ♂.
C. fallax subsp. *subbarbatus* Wheeler, Jour. N. Y. Ent. Soc., Vol. 18, p. 229 (1910) ♀ ♀ ♂.
C. marginatus subsp. *subbarbatus* var. *paucipilis* Emery, Zool. Jahrb. Syst., Vol. 7, p. 677 (1893) ♀ ♂.
Type loc: District of Columbia. Types: A.M.N.H., M.C.Z., U.S.N.M.
Range: northeastern United States south to Virginia and west to Iowa.

Since *subbarbatus* is so strictly confined to the northeastern and north central states, it is difficult to account for the specimens which Wheeler reported from Los Angeles. These had been sent him by Emery and were, in all probability, representatives of *clarithorax*. It is equally difficult to determine the exact character of *paucipilis*. Emery seemed inclined to regard this insect as an intergrade between *subbarbatus* and *nearcticus*. It seems to me, however, that this may be doubted. If these two species tended to intergrade, other specimens similar to *paucipilis* would certainly have been discovered, for the two species have virtually coincidental ranges over much of the northeastern United States. It seems more logical to suppose that *paucipilis* represents nothing more than an abraded specimen of *subbarbatus* in which some of the erect hairs on the genae had been rubbed away. It was, apparently, described from very few specimens and this may make it impossible of exact determination, even though the types are reëxamined. Until more is known about this insect it seems inadvisable to attempt to separate it from *subbarbatus*.

Subgenus Colobopsis Mayr

In both habits and structure the ants which belong to the subgenus Colobopsis are highly remarkable. The head of the female and that of the major worker resembles a cork, both in its shape and the use to which it is put. The head is virtually cylindrical with the anterior face abruptly truncated. If this truncated portion is viewed from directly in front, it will be seen to consist of the clypeus, the adjacent

portions of the cheeks and the mandibles. The eyes, antennae and antennal lobes are not visible from this view of the head. To see them it is necessary to look at the upper surface of the head. The truncated anterior face of the head is often edged with a distinct raised rim and not infrequently the surface of the head within this rim forms a shallow, saucer-like concavity.

The insects nest in hollow twigs or galls and there is usually only one opening to the nest. This opening is circular and just large enough to permit the head of the major to be thrust into it like a loosely fitting cork in the neck of a bottle. The major worker thus acts as a living door which can be opened at appropriate intervals to permit the minor workers of the colony to leave or return to the nest. Wheeler has shown (1904) that the signal given by the returning worker which opens the "living portal" is a tactile one. When the head of the major is in the position to block the nest entrance, neither the eyes nor the antennae can function to receive stimuli from outside. Yet when the front of the head is touched by the antennae of the minor worker the "door" opens. Wheeler was unable to elicit this response by stroking the head of the "janitor" with a straw or pin. There is, therefore, probably more than a simple tactile response involved. Wheeler also presented good evidence to show that the nest founding female of Colobopsis occludes the nest opening in the same fashion as does the major. The group shows a further structural peculiarity in the absence of the media workers.

The ants of this subgenus are abundant only in the southern portion of the United States. A single species, *cerberulus*, is known from Arizona but the rest of the species are largely confined to a region which extends from Texas and Oklahoma eastward to the Atlantic. North of this region the abundance of these insects shows a notable decrease. Indeed, even within the area just mentioned, the incidence of the colonies appears to be greater in the southern portions of the range. In my opinion the abundance of these insects in the region north of the Gulf Coast is much greater than the records would indicate. The nests are always obscure and often wholly inaccessible to ordinary collecting. In addition to nesting in the hollow stalks of weeds and galls, many of the species prefer to nest in hollow twigs of living trees (hickory, pecan, white ash, etc.), hence the only satisfactory way to collect them is to examine the twigs when the trees are felled. I recall one occasion of this sort when I was able to go over the freshly cut limbs of trees which were being lumbered off in a swamp area near Taylorsville, Mississippi. In the course of two or three hours I secured more Colobopsis colonies than I had been able to find in several months of ordinary collecting.

Key to the species of Colobopsis[1]

1. Length of the major worker 3.75 mm. or less ..... *obliquus*
   Length of the major worker 4.5 mm. or more 2
2. The angle where the side of the head meets the truncated anterior face surmounted by a distinct, narrow flange or rim; sculpture of the anterior face consisting of small shallow punctures and fine reticulation 3
   The angle where the side of the head meets the truncated anterior face serrate or blunt but not surmounted by a distinct flange; sculpture of the anterior face coarsely punctate and heavily reticulate 4
3. The flange at the lateral margin of the head with an almost perpendicular inner face, the area within the flange flat or nearly so; clypeus with a raised median strip of reticulo-rugose sculpture ..... *etiolatus*
   The flange at the lateral margin of the head with a sloping inner face, the area within the flange notably concave; clypeus uniformly sculptured .... *mississippiensis*
4. Punctures on the head of the major coarse but shallow, the angle between the side of the head and the truncate anterior face rounded and not serrate *pylartes* subsp. *fraxinicola*
   Punctures on the head of the major both coarse and deep, the angle between the side of the head and the truncate anterior face sharp and serrate 5
5. Promesonotum of the major feebly convex in profile and no higher (sometimes a little lower) than the dorsum of the epinotum; epinotum of the minor acutely angular with a deep impression at the mesoepinotal suture *pylartes*
   Promesonotum of the major moderately to strongly convex and always higher than the dorsum of the epinotum; angle of the epinotum in the minor rounded with the mesoepinotal suture only slightly or not at all impressed 6
6. Crest of the petiole with a distinct concave impression in the middle; color golden yellow with only the posterior abdominal segments brown ... *hunteri*
   Crest of the petiole flat or feebly convex; head and thorax reddish brown, abdomen piceous brown ..... *impressus*

34. Camponotus (Colobopsis) cerberulus Emery

C. (C.) cerberulus Emery, Bull. Soc. Ent. Ital., Vol. 52, p. 34 (1920) ♀; Wheeler, Bull. Mus. Comp. Zoöl., Vol. 77, No. 5, p. 214 (1934) ♀.
Type loc: Michoacan, Mexico. Types: none in this country.
Range: mountains of southern Arizona into Mexico.

Emery described this species in 1920 from a single female taken in Mexico. It did not appear again in the literature until 1934. At that time Wheeler described what he regarded as the major worker of

[1] Emery's *cerberulus* does not appear in the key, as it is known from the sexual phases only. In 1934 Wheeler described what he believed to be the major of this species but, as his association is problematical, it seems less confusing to omit this little known species.

cerberulus. The association was a roundabout matter. Wheeler had three major workers which were taken in acacia spines near Vera Cruz. These were similar to females coming from the mountains of southern Arizona. These were regarded as *cerberulus* by Wheeler. It may be that Wheeler is correct but this cannot be determined until a nest series containing all the castes has been secured. Until this can be done Wheeler's association is open to doubt. There is a further possibility that the females from southern Arizona are not *cerberulus* but an unnamed species. I strongly suspect that this is the case, for Emery's type came from the state of Michoacan, almost a thousand miles to the south of the Arizona border. Further study may show that *cerberulus* does not occur in the United States.

35. Camponotus (Colobopsis) etiolatus Wheeler

C. abditus var. *etiolatus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 150, fig. 5 (1904) ♀ ♀♂; Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 352 (1910) ♀.

C. (*C.*) *etiolatus* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 77, No. 5, p. 216 (1934); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 608, pl. 19, fig. 71 (1947) ♀.

Type loc: Austin, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: central Texas.

Although Wheeler originally described *etiolatus* as a variety of *abditus*, he later concluded that it is a closely related but distinct species. I have followed his suggestion in the present volume, but it should be borne in mind that there is nothing in our rather meager data on the distribution of these two insects which would prevent *etiolatus* from being regarded as a northern race of *abditus*. The two forms occupy wholly separate ranges, *abditus* occurring from Guatemala north into Mexico and *etiolatus* being confined to south central Texas. When more is known of the ant fauna of northeastern Mexico, we may discover, in that region, the junction of the two ranges.

36. Camponotus (Colobopsis) hunteri Wheeler

C. (*C.*) *pylartes* var. *hunteri* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 353 (1910) ♀.

Type loc: Victoria, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.

In his original description of *hunteri*, Wheeler dealt entirely with color characteristics by which this form can be separated from *py-*

lartes. It is curious that he should have overlooked the strikingly different thoracic structure of the two insects. In *hunteri* the epinotum is rounded, with the mesoepinotal suture unimpressed or nearly so, a condition which allies *hunteri* to *impressus* rather than to *pylartes*. It is certain that *hunteri* is not a color variety of *pylartes* and since it, *pylartes* and *impressus* all occur in eastern Texas without intergradation, it seems necessary to treat *hunteri* as a separate species.

37. Camponotus (Colobopsis) impressus (Roger)

Colobopsis impressa Roger, Berl. Ent. Zeitschr., Vol. 7, p. 160 (1863) ♀; Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 423 (1886) ♀ ♁.

C. (*C.*) *impressus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 681 (1893) ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 144, fig. 3 (1904) ♀ ♁ ♀.

Type loc: Georgia. Types: none in this country.

Range: southeastern United States north to latitude 35° and west to central Texas.

38. Camponotus (Colobopsis) mississippiensis M. R. Smith

C. (*C.*) *mississippiensis* M. R. Smith, Psyche, Vol. 30, p. 83 (1923) ♀ ♁; M. R. Smith, Ent. News, Vol. 35, p. 127 (1924) ♁.

Type loc: Starkville, Mississippi. Types: A.M.N.H., M.C.Z., Coll. M. R. Smith.

Range: Mississippi and Alabama.

39. Camponotus (Colobopsis) obliquus M. R. Smith

C. (*C.*) *obliquus* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 23, p. 567 (1930) ♁.

Type loc: Starkville, Mississippi. Types: M.C.Z., Coll. Dept. Ent. A. & M. Coll. Miss., Coll. M. R. Smith.

Range: known only from type material.

40. Camponotus (Colobopsis) pylartes Wheeler

C. (*C.*) *pylartes* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 147 (1904) ♀ ♀.

Type loc: Delvalle, Texas. Types: A.M.N.H., M.C.Z.

Range: Gulf Coast region of Texas and Louisiana.

41. Camponotus (Colobopsis) pylartes fraxinicola M. R. Smith

C. (*C.*) *pylartes* subsp. *fraxinicola* M. R. Smith, Psyche, Vol. 30, p. 86 (1906) ♀ ♁.

Type loc: Starkville, Mississippi. Types: A.M.N.H., M.C.Z., Coll. M. R. Smith.

Range: Mississippi and Alabama.

I have followed Dr. Smith in considering this insect as a subspecies of *pylartes*. It is, apparently, an eastern race of that species.

Subgenus MYRMOTHRIX Forel

The subgenus Myrmothrix is a comparatively small Neotropical group which is represented in the southern United States by two subspecies of the widespread *abdominalis*. The subspecies *floridanus* occurs not only in Florida but also, with decreasing frequency, along the Atlantic seaboard to North Carolina. Its western range seems much more sharply limited. In Alabama it appears to be confined to the area lying between the Perdido River and Mobile Bay. It should be present in that part of Alabama which lies immediately north of Florida, but if it occurs there it is very scarce. I have never been able to find *floridanus* in that part of Alabama which lies to the west of Mobile Bay, nor has Dr. Smith recorded it from Mississippi. This distribution suggests that *floridanus* originally entered the United States from the Antilles. Unfortunately for this theory, the nearest and only Antillean representative of *abdominalis* is the subspecies *nocens*, which occurs in Grenada. From a spatial standpoint, therefore, the nearest relative of *floridanus* is the Texan subspecies *transvectus*. Although the ranges of the two are separated by a gap of more than five hundred miles, I believe that *floridanus* ought to be considered as a subspecies of *abdominalis*. The structural differences which mark *floridanus* are in all respects comparable to those which distinguish the series of spatially adjacent forms which extend from northern Mexico to southern Brazil.

Scarcely anything has been published on the habits of *transvectus* but those of *floridanus* are well known. The insect forms rather populous colonies in and under rotten logs, stumps, etc. Occasionally the nests are begun under stones. It is an active, aggressive ant and has been reported as a pest of bee hives, which it enters and plunders. According to the writer's observation, *floridanus* prefers to nest in rather damp situations, such as the swales along stream bottoms, rather than on high, dry ground.

Key to the subspecies of C. (Myrmothrix) abdominalis Fabricius

1. Head entirely ferrugineous red; cheeks with small foveolae and without erect hairs..... *abdominalis* subsp. *floridanus*
   Head dark brown or black at the vertex; cheeks with deep, elongated foveolae and erect hairs..... *abdominalis* subsp. *transvectus*

42. Camponotus (Myrmothrix) abdominalis floridanus (Buckley)

Formica floridana Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 161 (1866) ♀.
C. atriceps var. *floridanus* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 223 (1886) ♀ ♀ ♂.
C. abdominalis subsp. *floridanus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 670 (1893); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 325 (1910) ♀ ♀.
C. (*M.*) *abdominalis* subsp. *floridanus* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 604, pl. 18, fig. 69 (1947) ♀.
C. atriceps subsp. *yankee* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 20, p. 340 (1884) ♀ ♀ ♂.
Type loc: Florida. Types: none known to exist.
Range: Florida, Georgia, South Carolina and the southeastern portion of Alabama.

43. Camponotus (Myrmothrix) abdominalis transvectus Wheeler

C. abdominalis transvectus Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 326 (1910) ♀ ♀ ♂.
Type loc: Harlingen, Texas. Types: M.C.Z.
Range: the Brownsville region of Texas and northeastern Mexico.

In the original description of *transvectus* the majority of the type series was said to have come from 'Harlington, Cameron County, Texas'. There is no such town in Cameron County and the name appears to have been an obvious misprint for Harlingen, a small town a few miles north of Brownsville. Wheeler also included Brownsville as one of the type localities of *transvectus*, since he had a single worker from that area. In this case it may seem pedantic to insist that only Harlingen be regarded as the type locality and that only the Harlingen specimens be considered the types. I prefer to do so, however, since the practice of citing multiple type localities cannot be justified and is certainly apt to produce confusion.

Subgenus Myrmobrachys Forel

The subgenus Myrmobrachys possesses only two forms whose northern range reaches the United States. One of these, *mina* subsp. *zuni*, occurs in southern Arizona. The other, *planatus*, is known from the Brownsville region of Texas and southern Florida. There has been a considerable difference of opinion as to the exact taxonomic status of specimens of *planatus* coming from the United States. American specialists have uniformly treated these as identical with the typical *planatus*, while European authorities have just as consistently re-

garded them as belonging to the subspecies *continentis*. I wish to review certain aspects of this difficulty since, as things stand at present, the literature contains some very confusing contradictions which no one has attempted to resolve. To secure an adequate idea of the problem one must, of course, consider the entire range of *planatus* and not merely those attenuated portions of it which lie within our borders. This range is considerable, for *planatus* occurs widely in Cuba and is fairly abundant on the continent from Mexico to Colombia. In the southern part of this range four subspecific variants have been recognized, of which only the subspecies *continentis* is of particular concern to this discussion. The subspecies *continentis* was set up by Forel in 1901 on the basis of material coming from Guatemala. There is fair evidence to show that Forel erected this subspecies without being aware of the exact nature of the typical *planatus*. Up to the year 1899 Forel had treated *planatus* as a subspecies of *senex* and until that year he made no attempt to describe variations in the population of *planatus*. Once Forel had acceded to Roger's original concept of *planatus* as a separate species, he began to discover infra-specific variants in *planatus*, which he duly described and named. I do not wish to imply that these variants are without significance but I do wish to emphasize that Forel and later Emery, who also interested himself in the continental variants of *planatus*, would never have named them unless they had believed them to be different from the insect which Roger had originally described. This may seem too obvious to require comment, yet it is the conviction that all the continental representatives of *planatus* are different from the typical Cuban form which is responsible for most of the trouble. In 1910 Wheeler published a very full description of all the phases of *planatus*, together with comments which made it clear that specimens of this insect coming from the southern United States are identical with those found in Cuba and parts of Mexico. In his description Wheeler took no cognizance of the described continental variants of *planatus* and, while he may have avoided a thorny issue by so doing, it seems clear that this neglect is what gave Emery the opportunity to treat Wheeler's description as that of the subspecies *continentis* rather than that of the typical *planatus*. At least this was what Emery did.

We may count ourselves fortunate that Roger based the species *planatus* on specimens coming from Cuba. The insect is not only abundant throughout the whole island but shows a remarkable uniformity of structure regardless of the station from which the specimens come. There can, therefore, be little question of races in the Cuban material and, if such material is available for examination, one may feel confident of the characteristics of the typical *planatus* with-

out reference to Roger's types. There is a substantial amount of *planatus* material from Cuba in various American collections, hence one may easily verify the fact, noted by Wheeler in 1910, that specimens of *planatus* coming from the United States are the same as the typical Cuban form. The difficulty lies in overcoming Emery's erroneous concept of the character of these specimens. Perhaps it would be more palatable to those who have accepted Emery's view if they realize that the facts stated by Wheeler do not necessarily invalidate the status of the subspecies *continentis*. Since the types of *continentis* came from Guatemala, it would not be surprising if they show a structural difference from those of northern Mexico, the southern United States and Cuba. But it is no paradox to say that the status of *continentis* can only be defended by giving up the idea that it is as inclusive as Emery supposed. For those who insist that our representatives of *planatus* belong to the subspecies *continentis* are actually arguing that *continentis* is a synonym of the typical *planatus*.

The habits of *planatus* have been repeatedly studied. The insect is arboreal and constructs its nests in decayed branches, hollow twigs and in the bases of bromeliads. The colonies are small and hard to find but the individual ants are conspicuous because of their foraging activities. They like to run along vines and are surprisingly difficult to catch, since they dodge around to the rear of the vine when disturbed. Very little is known of the habits of *mina* subsp. *zuni* but it is probable that it is not so thoroughly arboreal as is *planatus*.

Key to the species of Myrmobrachys

1. Antennal scapes of the major slightly surpassing the posterior corners of the head; head and thorax deep, ferrugineous red ..... *planatus*
   Antennal scapes of the major reaching but not surpassing the posterior corners of the head; head, thorax and gaster black ..... *mina* subsp. *zuni*

44. Camponotus (Myrmobrachys) planatus Roger

C. planatus Roger, Berl. Ent. Zeitschr., Vol. 7, p. 148 (1863) ♀ ♀ ♂; Forel, Biol. Centrali Amer. Hym., Vol. 3, p. 141 (1899); Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 371 (1901); Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 348 (1910) ♀ ♀ ♂.

C. (*M.*) *planatus* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 608, pl. 19, fig. 74 (1947) ♀.

Type loc: Sarabanda, Cienaga de Zapata, Cuba. Types: none in this country.

Range: Cuba, southern Florida, the Brownsville area of Texas and northern Mexico.

45. Camponotus (Myrmobrachys) mina zuni Wheeler

C. mina subsp. *zuni* Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 346 (1910) ♀ ♁.
Type loc: Tucson, Arizona. Types: M.C.Z., A.M.N.H.
Range: rather widely distributed in southern Arizona. A number of the records come from low elevations in mountain ranges but the insect also occurs in open desert flats.

Subgenus Myrmaphaenus Emery

Since the publication of the formicine section of the *Genera Insectorum* in 1925, it has been customary to follow Emery in his allocation of the species *bruesi* and *yogi* to the subgenus Myrmaphaenus. The present treatment does not depart from this practice, but it seems well to note certain weaknesses of the subgenus Myrmaphaenus which may make further revision necessary when some of the constituent species are better known. Up to the year 1920, most of the species at present in Myrmaphaenus had been a part of a larger assemblage to which Forel gave the subgeneric name Myrmamblys in 1912. As originally constituted, Myrmamblys contained species from both the Old World and the New World tropics. The common structural features which were supposed to mark this group were a medium stature, an elongate head with the sides parallel or nearly so and with the upper surface often obliquely truncate. The media caste was frequently absent which resulted in a strong dimorphism in most species. But it was freely admitted that a number of species originally included in Myrmamblys failed to meet all the above criteria. Thus, from the outset, the subgenus possessed a degree of heterogeniety that was high, even for a subgenus of Camponotus. In 1920 Emery attempted to better this situation by removing from Myrmamblys a small number of Neotropical species which he placed in the new subgenus Myrmaphaenus. At the same time he restricted the subgenus Myrmamblys to those species previously known as the *novogranadensis* and *capperi* groups and erected two other subgenera to receive the Old World Myrmamblys (Myrmotemnus) and the New World *salvini* group (Paracolobopsis). It is to be regretted that Emery failed in this attempt for in many respects his plan is superior to the present arrangement. But Emery had neglected the fact that Wheeler had designated *reticulatus* as the subgenotype of Myrmamblys in 1913. This meant that the name Myrmamblys would have to be applied to the Old World species and that Emery's Myrmotemnus would fall as a synonym of Myrmamblys. It also meant that a new name would be necessary for the species of the *novogranadensis* and *capperi* groups

and for this subgenus Wheeler proposed the name Neomyrmamblys. All this was strictly legal and proper but it seems to have been more than Emery could stand. For once he lost his temper to the extent that he preferred to jettison his own work rather than accept Wheeler's proposal. There was nothing he could do about the name Myrmamblys, which had to be applied to the subgenus containing the Old World species. But he could and did block the use of Wheeler's name Neomyrmamblys by the simple, though unfortunate, expedient of expanding the subgenus Myrmaphaenus to include all the New World species which he had divided into three subgeneric groups five years earlier. His own subgenus Paracolobopsis disappeared along with Wheeler's Neomyrmamblys and the reconstructed subgenus Myrmaphaenus which resulted was scarcely less heterogeneous than was the old subgenus Myrmamblys from which it had been split.

I have presented the above discussion because it is necessary to appreciate that the diversity of structure in the subgenus Myrmaphaenus permits an unusually wide latitude in the case of the species which may be included in it. This causes little difficulty as far as the species *bruesi* is concerned, since this insect is closely related to other species in the *novogranadensis* complex and will have to be included with them regardless of any subdivisions which may later be made in the subgenus Myrmaphaenus. Emery was clearly convinced that *yogi* falls into this category also, but his view is by no means convincing. As I shall show, there is no way at present of exactly determining the subgeneric status of *yogi*. The species was described by Wheeler in 1915 from two specimens, a major and a minor worker. As far as I have been able to ascertain, these specimens were the only representatives of this species ever taken. At the time when Wheeler described *yogi*, he was of the opinion that it was related to the subgenus Colobopsis, but he did not commit himself on this point in 1915. Two years later, however, he definitely assigned *yogi* to the subgenus Colobopsis. It is important to remember in this connection that in 1917 the old subgenus Myrmamblys had been in existence for five years. Moreover Wheeler had, in 1913, proposed *reticulatus* as its subgenotype. We cannot suppose that Wheeler was not aware of the general characteristics of the subgenus Myrmamblys and the conclusion is inescapable that when he assigned *yogi* to Colobopsis, he did so because he felt that it fitted better there than in Myrmamblys. It is not easy, under such circumstances, to justify Emery's contrary opinion. On the other hand, it is equally difficult to disprove it. Emery undoubtedly used Wheeler's description of *yogi* as the basis for his allocation of that species to Myrmaphaenus. Those who seek to clarify the situation will be forced to follow suit, for the types of

yogi are either lost or misplaced. I have been unable to find them in the collection of the Museum of Comparative Zoölogy or in that of the American Museum of Natural History. For this reason I have acceded to Emery's treatment of *yogi*, for as things stand now any additional opinion on the status of *yogi* may make the existing confusion worse.

Little is known about the habits of *bruesi* and *yogi*. The types of *bruesi* were taken on the trunk of an acacia tree at Ft. Davis, Texas. The insect is fairly common on the small oaks which occur at the mouths of several of the canyons in the Huachuca Mountains. They are very active and rather timid insects and the nests are difficult to find. After much searching I found several clusters of workers under the loose bark of partially decayed branches. I do not think that any one of these clusters could have been the main part of the nest. They seemed to be superficial parts of nests whose main passages followed areas of decaying wood deep in the branches and trunk of the trees. The two type specimens of *yogi* were taken from a hollow twig of manzanita.

Key to the species of Myrmaphaenus

1. Antennal scapes of the major reaching the posterior corners of the head; frontal lobes divergent anteriorly; color testaceous yellow ..... *yogi*
   Antennal scapes of the major surpassing the posterior corners of the head by one third of their length; frontal lobes parallel anteriorly; color piceous black with the front of the head brownish ..... *brues*

46. Camponotus (Myrmaphaenus) bruesi Wheeler

C. bruesi Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 349 (1910) ♀ ♁.
C. (*M.*) *bruesi* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 608, pl. 19, fig. 72 (1947) ♁.
Type loc: Ft. Davis, Texas. Types: M.C.Z., A.M.N.H.
Range: western Texas to southern Arizona and south into Mexico.

47. Camponotus (Myrmaphaenus) yogi Wheeler

C. yogi Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 420 (1915) ♀ ♁.
Type loc: Point Loma, San Diego, California. Types: apparently lost or misplaced.
Range: known only from type material.

Subgenus MANNIELLA Wheeler

The subgenus Manniella was set up by Wheeler in 1921 to receive the Cuban species *sphaericus* and its subspecies *sphaeralis*. Emery later placed *ulcerosus* in this subgenus. I have followed Emery's treatment in this work, although it must be confessed that the two species show a rather striking difference in cephalic structure of the major. The peculiar ulcer-like concavities which give *ulcerosus* its name are entirely confined to the cheeks and do not involve the frontal lobes. The latter are of normal configuration. In the major of *sphaericus* the depressed areas occur not only on the cheeks but also involve the anterior part of the frontal lobes. The two species thus present a very different appearance. Since the subgenus Manniella was based mainly on the cephalic structure of *sphaericus*, it follows that *ulcerosus* does not fit too well in the subgenus. But it is certainly better there than in Colobopsis, to which Forel attempted to assign it. For the head of *ulcerosus* is not cylindrical in cross section and the angle of truncation is very oblique, so that when the head is seen from the side its outline is that of a stubby wedge. The unique structural features which mark the major of *ulcerosus* are not found in the minor. These are remarkably like the minors of *bruesi* and differ from them mainly by their slightly larger size and more abundant erect body hairs. The minors of *ulcerosus* are also a little less shining than those of *bruesi*. The coloration of the two is virtually identical.

The habits of *ulcerosus* also indicate that it cannot properly be grouped with Colobopsis. The nests which Wheeler found in the Huachuca Mountains were built under large stones.

48. CAMPONOTUS (MANNIELLA) ULCEROSUS Wheeler

C. ulcerosus Wheeler, Ann. N. Y. Acad. Sci., Vol. 20, p. 351 (1910) ♀.

C. (*M.*) *ulcerosus* Emery, in Wytsman, *Genera Insectorum*, Fasc. 183, pl. 3, fig. 12 (1925) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 608, pl. 19, fig. 73 (1947) ♀.

Type loc: Parmerlee, Huachuca Mountains, Arizona. Types: A.M.N.H.

Range: mountains of southern Arizona at elevations of 5000–6000 feet.

Genus PARATRECHINA Motschoulsky

(Plate 51, figures 1–4)

The situation which exists in the taxonomy of Paratrechina is most depressing. At present the genus is in a condition which looks very much like a hopeless muddle. Nor is there much that can be done to

improve the matter until someone is willing to undertake the arduous and extensive revisionary work that is so obviously needed. Much of this difficulty can be traced to the fact that specific distinctions in this genus are, at best, very subtle. This should have been enough to place a check on the description of subspecies and varieties in this group, and most myrmecologists seem to have appreciated this clearly. But Forel had no such compunctions and proceeded to load up certain species (*vividula, fulva, bourbonica,* etc.) with such a plethora of varieties and subspecies that these species have gone to pieces under the strain. It is no novelty to find such complexes in formicid taxonomy, and those in the subgenus Nylanderia are smaller than some which occur in other genera, but there is one unusual difference. In Nylanderia the structural distinctions which mark many of the subspecies are entirely comparable to specific differences elsewhere in the group. It is extremely difficult to deal with such a situation in a logical fashion, for the extent of specific limits in Nylanderia is a much more arbitrary matter than is usually the case with ant genera. There can be little doubt that these considerations have played a large part in turning the attention of myrmecologists to genitalic differences in the males of Nylanderia. Extensive use has been made of the structure of the middle genital valve as an index of specificity, but even with this as an aid the difficulties have not been invariably overcome. In many cases the differences shown by the male genitalia are less pronounced than could be wished, thus even this supposedly infallible criterion is open to different interpretations. It would seem that the most promising solution for the difficulties of this forbidding group may lie in zoögeographical analysis. At least this method should enable us to establish with reasonable certainty which forms are species and which are subspecies. This will, however, be no easy task, for the widespread distribution of the group in the warmer parts of the world and the vagrant tendencies of many of the species make this type of analysis exceptionally difficult.

The habits of our representatives of Paratrechina are not very striking and as long as these insects remain outdoors they seldom attract much attention. Occasionally, however, they make pests of themselves by entering dwellings or greenhouses. The imported *longicornis* is particularly liable to do so. The species often make nests in the soil which are surmounted by small, irregular craters of excavated earth. At other times they nest under stones or beneath moss. They feed upon honey-dew from aphids, nectar and the tissues of other insects.

The following key does not contain the undetermined form of *bourbonica* which has been taken in Florida and South Carolina. The reason for this omission is explained on a subsequent page.

Key to the species of Paratrechina

1. Antennal scapes at least twice as long as the head; body with distinct blue or violaceous reflections (Subgenus *Paratrechina*) ..... *longicornis*
   Antennal scapes less than twice as long as the head; body without violaceous reflections (Subgenus *Nylanderia*) 2
2. Antennal scapes without erect hairs ..... *parvula*
   Antennal scapes with at least a few erect hairs on the anterior surfaces, usually many more present 3
3. Length 4–4.5 mm.; erect hairs abundant on all surfaces of the tibiae; appressed pubescence prominent on the head and gaster ..... *fulva*
   Length 3 mm. or less; erect hairs on the tibiae mainly confined to the extensor surfaces; appressed pubescence absent or very obscure on the head and gaster 4
4. Erect hairs on the antennal scapes abundant and occurring on the sides as well as the front of the scape, absent only from the rear surface 5
   Erect hairs on the antennal scapes sparse and almost entirely confined to a single row on the front of the scape 6
5. Color clear yellow ..... *vividula* subsp. *guatemalensis*
   Color piceous brown ..... *vividula*
6. Antennal scapes surpassing the occipital margin by only a little less than half their length 7
   Antennal scapes surpassing the occipital margin by not more than one-third their length ..... *bruesi*
7. Head (except in very small workers) as broad as long or a little broader than long; erect hairs on the upper surface of the body rather sparse and not very long ..... *melanderi*
   Head a little longer than broad; erect hairs on the upper surface of the body long and abundant ..... *melanderi* subsp. *arenivaga*

Subgenus PARATRECHINA Motschoulsky

1. PARATRECHINA LONGICORNIS (Latreille)

(Introduced)

Formica longicornis Latreille, Fourmis, p. 113 (1802) ♀.

Paratrechina longicornis Emery in Wytsman Genera Insectorum, Fasc. 183, pl. 4, fig. 8, 8a (1925) ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 610, pl. 20, fig. 75 (1947) ♀.

Prenolepis longicornis Roger, Verz. Formicid., p. 10 (1863); Mayr, Reise Novara Formicid., p. 50 (1865) ♀; Mayr, Tijdschr. v. Ent., Vol. 10, p. 72 (1867) ♀ ♀; E. André, Ann. Soc. Ent. Fr. (6), Vol. 1, p. 60 (1891) ♂; E. André, Spec. Hym. Europe, Vol. 2, p. 203 (1882) ♀ ♀ ♂; Forel, in Grandidier, Hist. Nat. Madagascar, Vol. 20 (2), p. 81, pl. 2, fig. 8 (1891) ♂; Forel, Jour. Bombay Nat. Hist. Soc., Vol. 8, p. 406 (1894) ♀ ♂; Bingham,

Fauna Brit. India Hym., Vol. 2, p. 326 (1903) ♀ ♀ ♂; Arnold, Ann. S. African Mus., Vol. 14, p. 605 (1922) ♀ ♀ ♂.

Prenolepis (*Nylanderia*) *longicornis* Emery, Deutsch. Ent. Zeitschr., p. 129, fig. 2, 3 (1910) ♀ ♀ ♂; Emery, Nova Caledonia Zool., Vol. 1, p. 422, nota (1914) ♀.

Formica vagans Jerdon, Madras Jour. Lit. Sci., Vol. 17, p. 124 (1851) ♀.

Formica gracilescens Nylander, Ann. Sci. Nat. Zool. (4), Vol. 5, p. 73, pl. 3, fig. 20 (1856) ♀.

Tapinoma gracilescens F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 56 (1858).

Paratrechina currens Motschoulsky, Bull. Soc. Nat. Moscow, Vol. 36, p. 14 (1863) ♀.

Type loc: Senegal, Africa. Types: none in this country.

Range: (in the United States) Florida to South Carolina and west to Texas and sporadically in residences, warehouses and greenhouses over much of the eastern United States.

This well known tropicopolitan species appears to be well established in the Gulf Coast area and it seems likely that in this area it can survive winter climate in the field. Climate, however, is not much of a hazard for this enterprising insect, for it adapts itself to life indoors with great readiness in northern stations. The ant is surprisingly abundant in New York City, where it infests warehouses and apartments.

Subgenus NYLANDERIA Emery

2. PARATRECHINA (NYLANDERIA) BOURBONICA Forel var.?

(Introduced)

The treatment which has been accorded this insect will show the hopeless confusion which exists in the case of some of the larger complexes in Nylanderia. Both Wheeler and M. R. Smith have reported a form of *bourbonica* from Florida but neither of them have attempted to state which variety is represented. Since Wheeler seemed certain that the insect had been introduced from the Orient, it may be assumed that it is at least related to the subspecies *amia*, which is the form most commonly encountered in southeastern Asia. Unfortunately I failed to examine this insect in the Wheeler Collection for I was under the impression that the form involved was the typical *bourbonica*. If the Florida material is, as I suppose, related to *amia*, it will run down in the key to *vividula*, from which it will differ in its lower and more evenly convex promesonotum which rises gradually from the mesoepinotal suture and has no distinct declivious face at

the rear. It should be obvious why it is impossible to present bibliographic references for this insect, although I am ready to admit that if I had been a little more alert, it might have been possible to do so.

3. Paratrechina (Nylanderia) bruesi (Wheeler)

Prenolepis bruesi Wheeler, Psyche, Vol. 10, p. 106, fig. 9 (1903) ☿ ♀ ♂.
Type loc: Fresno Canyon, Presidio County, Texas. Types: A.M.N.H., M.C.Z.
Range: southwestern Texas along the Gulf Coast to southern Alabama.

Wheeler seems to have slightly overestimated the scape length of *bruesi*. In the original description of *bruesi* the length given for the scape is the same as that for *melanderi*. It is my opinion that the scape of *bruesi* is notably shorter than that of *melanderi* and this seems to be the best feature for the separation of these two species. The insect which Pergande described as *P. anthracina* var. *nodifera* in 1895 was associated by Emery with *bruesi*. This association seems scarcely justified in view of the differences which may be observed in Pergande's description. There is also the difficulty that Pergande's material came from central Mexico and the tip of Lower California. Further study will be needed to determine the nature of Pergande's material but it would seem unnecessary to carry the reference to his description in the bibliography of *bruesi* any longer.

4. Paratrechina (Nylanderia) fulva (Mayr)

(Introduced)

Prenolepis fulva Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 698 (1862) ☿ ♀; Mayr, Reise Novara Formicid., p. 51, pl. 2, fig. 14 (1865) ☿ ♀; Mayr, Zool-bot. Ges. Wien, Vol. 20, p. 947 (1870) ☿; Forel, in Grandidier Hist. Nat. Madagascar, Vol. 2 (2), p. 93, pl. 3, fig. 3 (1891) ♂; Emery, Nova Caledonia Zool., Vol. 1, p. 422 nota (1914) ☿.
P. fulva subsp. *pubens* Emery, Zool. Jahrb. Syst., Vol. 7, p. 636, pl. 22, fig. 24 (1893) ☿ ♂.
Type loc: Brazil. Types: none in this country.
Range: (in the United States) extreme southern Texas and sporadically in greenhouses as far north as New Jersey.

There has been much confusion regarding this insect. Prior to 1893 Pergande sent specimens from Washington, which he had secured in a hot house belonging to the Department of Agriculture, to Emery and Forel. The specimens were used by Forel as a part of the type

series for the subspecies *pubens*, which he described from the Washington material and other specimens coming from St. Vincent, B.W.I. Emery stated flatly that the workers of Pergande's material were identical with those of the typical *fulva* from Brazil. However, Emery managed to ennumerate some slight differences in the case of the male. The head of this insect was a little longer than that of the type and its outer genital valve was a trifle more hairy. But Emery could see no difference in the structure of the median genital valve, which usually is the part most relied upon for specific differences. It seems to the writer that Emery's efforts to support Forel only proved all the more conclusively that Forel was incorrect in his treatment of the specimens which he had from Pergande. This does not mean that Forel's *pubens* must be considered a synonym of *fulva* for the specimens from St. Vincent may be subspecifically distinct. But it does mean that specimens from the United States which we have been calling *pubens* are actually the typical *fulva*. There is no room for doubt on this score for the agreement between our specimens and those from Brazil is startling. It is of interest to note that while all of the northern records of *fulva* have come from greenhouses, the insect has acclimated itself to outside conditions in extreme southern Texas. I have before me a series of workers taken in the field at Brownsville by Dr. P. J. Darlington.

5. Paratrechina (Nylanderia) melanderi (Wheeler)

Prenolepis melanderi Wheeler, Psyche, Vol. 10, p. 104, fig. 8 (1903) ♀ ♀ ♂.
P. (*N.*) *vividula* subsp. *melanderi* Emery, Ann. Soc. Ent. Belg., Vol. 50, p. 132, fig. 5 (1906) ♂.
Type loc: New Braunfels, Texas (by present restriction). Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: Tennessee to western Texas and south into Mexico.

I cannot agree with Emery that *melanderi* ought to be treated as a subspecies of *vividula*. Emery's association was based in large part on a consideration of genitalic structure in the male and his reasons for arriving at this decision are far from compelling. Emery could not claim that the genitalia of *melanderi* are identical with those of *vividula*, for they certainly are not. But Emery considered the similarity sufficiently close to warrant associating the two forms. This, of course, is entirely a matter of how one wishes to interpret existing differences and these same differences could be cited in support of the separate specificity of *melanderi*. But it would seem unnecessary in this case to put so much stress on male structure, since there are significant

differences which separate the worker of *melanderi* from that of *vividula*. In the first place, there is a notable difference in head shape in the two species. Because the shape of the head varies slightly with the size of the worker, it is difficult to generalize in this matter. But it may be said that the head of *vividula* is usually narrower behind the eyes than in front of them, with the occipital angles notably rounded. In no case is the head of *vividula* broader at the rear than in front although in some specimens the width is about the same at the front and the rear of the head. In *melanderi* this situation is reversed. The head is usually broader behind the eyes than in front of them and never narrower at the occiput than at the insertion of the mandibles. But one may as well admit that it is possible to select from each species individuals in which the head shape is very similar. These, however, seem to be the exception and not the rule. A difference which is much more constant, although of less magnitude, is the pilosity of the scapes. This difference is given in the key and need not be repeated here, but it may be said that it will hold for every form of *vividula* which the writer has been able to examine and would, therefore, seem to be a very useful distinction.

I further believe that *arenivaga* will have to be considered as a subspecies of *melanderi*. This is an interesting point, for it may be recalled that Emery was perfectly willing to accord separate specific status to *arenivaga* although denying it to *melanderi*.

6. Paratrechina (Nylanderia) melanderi arenivaga (Wheeler)

Prenolepis arenivaga Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 391, fig. 3 (1905) ♀ ♂.

Prenolepis arenivaga var. *faisonensis* Forel, Rev. Suisse Zool., Vol. 30, p. 98 (1923) ♀.

Type loc: Lakehurst, New Jersey. Types: A.M.N.H., M.C.Z.

Range: New Jersey to the Gulf Coast.

The worker of *arenivaga* is so similar to that of *melanderi* that its status as a separate species could scarcely have been defended had it not been for the differences which Wheeler described in the genitalia of the male. Wheeler's figures of the median genital valve of *arenivaga* show a bilobed structure in which the two lobes are of approximately the same length. In *melanderi* the inner lobe is much shorter than the outer one and curved against it. The writer has examined the genitalia of a number of males of *arenivaga* taken in the type locality and has found that in every case they are much more like Wheeler's figure of *melanderi* than his figure of *arenivaga*. In point of fact they do not seem to resemble the figure of *arenivaga* at all. The inner lobe is less

than half as long as the outer and has its tip curved against a row of tiny tubercles which extend along the side of the outer lobe (as in *melanderi*). The conspicuous terminal cluster of tubercles which Wheeler shows in his figure of *arenivaga* is entirely absent. I confess that I cannot easily account for these discrepancies, but I feel certain that the male genitalia of *arenivaga* are much more like those of *melanderi* than Wheeler supposed. Finally I believe that I have fairly conclusive evidence, from specimens taken in southern Alabama, to show that *melanderi* and *arenivaga* intergrade in that area. For the above reasons I have treated *arenivaga* as a subspecies of *melanderi*. Forel's variety *faisonensis* is, in my opinion, a straight synonym of *arenivaga*.

7. Paratrechina (Nylanderia) parvula (Mayr)

Prenolepis parvula Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 948 (1870) ♀ ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 7, p. 636, pl. 22, fig. 23 (1893) ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 390, fig. 2 (1905) ♂.

P. (*Nylanderia*) *parvula* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 610, pl. 20, fig. 76 (1947) ♀.

Prenolepis vividula subsp. *parvula* Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 20, p. 348 (1884).

Prenolepis parvula var. *grandula* Forel, Rev. Suisse Zool., Vol. 30, p. 98 (1923) ♀.

Type loc: New York. Types: none in this country.

Range: southern New York west to Iowa, south to Florida and southwest to Texas.

Forel's variety *grandula* is nothing more than one of the slight fluctuations in size and color which appear over the entire range of *parvula*. The color of this species is particularly variable. Specimens from the southern part of the range are sometimes pale yellow with only the gaster slightly infuscated. There is, however, nothing that would indicate that these fluctuations have any distributional significance. On the other hand the absence of erect hairs on the scapes of this species seems to be a highly constant and very reliable separatory feature. The writer has never seen the slightest tendency toward intermediate conditions in this character.

8. Paratrechina (Nylanderia) vividula (Nylander)

(Introduced)

Formica vividula Nylander, Acta. Soc. Sci. Fennic., Vol. 2, p. 900, pl. 18, fig. 2, 10–14 (1846) ♀ ♀ ♂.

Prenolepis vividula Mayr, Europ. Formicid., p. 52 nota (1861).

Prenolepis (*Nylanderia*) *vividula* Emery, Ann. Soc. Ent. Belg., Vol. 50, p. 130, fig. 1–4 (1906); Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 154 (1908); Emery, Deutsch. Ent. Zeitschr., p. 131, fig. 6, 7 (1910) ♀ ♀ ♂; Emery, Nova Caledonia Zool., Vol. 1, p. 422 nota (1914) ♀.

Formica vividula Nylander, Ann. Sci. Nat. Zool. (4), Vol. 5, p. 66, pl. 3, fig. 5, 21 (1856) ♀ ♀ ♂.

Tapinoma vividula F. Smith, Cat. Hym. Brit. Mus., Vol. 6, p. 56 (1858).

Type loc: Antilles? Types: none in this country.

Range: (in the United States) Florida and Mississippi and sporadically in greenhouses in many parts of the country.

9. Paratrechina (Nylanderia) vividula guatemalensis (Forel)

(Introduced?)

Prenolepis guatemalensis Forel, Bull. Soc. Vaud. Sci. Nat., Vol. 20, p. 348 (1884) ♀; Forel, Trans. Ent. Soc. Lond., p. 340 (1893); Emery, Nova Caledonia Zool., Vol. 1, p. 422 nota (1914) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 392, fig. 4 (1905) ♂.

Prenolepis (*Nylanderia*) *vividula* var. *guatemalensis* Forel, Mem. Soc. Ent. Belg., Vol. 20, p. 66 (1912).

Type loc: Guatemala. Types: A.M.N.H., M.C.Z.

Range: (in the United States) southern Arizona.

As far as the writer has been able to determine the only record for *guatemalensis* in the United States is the one published by Emery in 1893. This record was based on a single worker taken in Phoenix, Arizona. The absence of any further records make it seem very likely that the insect failed to establish itself in that area.

Genus Prenolepis Mayr

(Plate 52, figures 1–4)

In 1930 Wheeler published an exhaustive account of the biology of *Prenolepis imparis*. The first part of this paper dealt with the habits, distribution and paleontological relationships of the insect. The second part was devoted to its taxonomy. In addition to the typical form Wheeler recognized nine varieties. Certain paleontological considerations with which Wheeler dealt seem to have had a considerable effect on his taxonomic treatment of *imparis*. It may be recalled that Wheeler believed that our present day representatives of *imparis* are scarcely more than varieties of the fossil *Prenolepis henschei* of the Baltic amber. Since Wheeler was defending the thesis that there has

been little change in this ant since the Oligocene, he relegated all the forms to the lowest taxonomic rank, the variety, although he considered that some of them represented 'incipient geographical races'. The importance of Wheeler's paleontological deductions need not be questioned, but it seems a dubious business to make them the basis for present day taxonomy. Despite the fact that *imparis* is, as Wheeler put it, 'constant morphologically', the insect does vary. There is no reason to suppose that these variations are different from those of other ants and they will have to be subjected to the usual analysis. If this is done it becomes apparent that it is not consistent to treat all of them in the same fashion. The structural differences which mark the variants are by no means of the same order throughout the group nor is there a notable uniformity in their distributional behavior.

Of the nine varieties treated in Wheeler's paper, only six occur in the United States. Counting the typical *imparis* as the seventh form, these seven fall into two groups on the basis of distribution. In the west the variants *coloradensis, arizonica* and *californica* occur. Since the first two forms are known only from type material or material which has been taken near the type locality, nothing positive can be said about their distributional characteristics. Nevertheless, there is no evidence at present that would prevent them from being considered as geographical races. It may be added that each form possesses structural features other than size and color by which they may be distinguished. For the above reasons they are much more distinct than the eastern variants and should, in my opinion, have subspecific status.

The situation as regards the eastern variants is quite a different matter. The four forms *imparis, minuta, testacea* and *pumila* have ranges that are so nearly coincidental that no satisfactory geographical distinction is possible. It is true that *pumila* and *testacea* appear to be more abundant in the southern states than in the north, while *imparis* reverses this situation, being more abundant in the north than in the south. But all four forms occur at random in a region extending from New York to northern Georgia and Alabama and west as far as Wisconsin and Missouri. Since they do not have separate ranges it seems unlikely that they are geographical races and this view is supported by the highly inconstant and inconsequential characters which are supposed to separate them. These characters consist entirely of differences of size and color. They might be summarized as follows:

imparis, large and dark
minuta, small and dark
testacea, large and light
pumila, small and light

The figures which Wheeler presented in 1930 make it appear that there is a notable and constant size difference involved and he also treats color differences in the same way. Unfortunately Wheeler's figures for size are, in most cases, unreliable. They will, apparently, apply only to the type material. An example of this is his treatment of *californica*. In the original description the size of that insect is given as 2.3–2.5 mm. On the following page Wheeler noted that the size of certain specimens of *californica* varies greatly, and that he has seen specimens in which the length was 2–3.5 mm. It is fortunate that the insect has separatory features other than size which permit its recognition. But this is not true of the eastern variants. They must be recognized on the basis of size and color if they are to be recognized at all. I would like to cite one example which will show the futility of such attempts. The size range which Wheeler regards as characteristic for *pumila* is 2.2–2.5 mm. in the worker caste. I have a considerable series of workers of *pumila* coming from Ft. Payne, Alabama. This material was a part of that on which Wheeler based his concept of *pumila*. I have recently measured many of these workers and have had difficulty in finding specimens less than 3 mm. in length. The majority of them were 3.5 mm., a length that would put them within the size range of *testacea*.

I have no hesitation in stating that it is impossible to separate *imparis, minuta, testacea* and *pumila* on the basis of the size differences cited by Wheeler in 1930. It seems equally impossible to utilize color distinctions. According to Wheeler the color of the worker of *imparis* varies from 'pale castaneous to dark piceous brown' while that of *testacea* is 'yellow or brownish or reddish yellow'. The difference between a pale castaneous brown and a brownish yellow is one which is too subtle for the writer to appreciate. It is my opinion that what we have in the case of the eastern variants is a single form whose size and whose coloration both vary considerably. The three varieties which have been named owe their existence to the fact that extreme conditions were selected for description. I do not deny that when extremes are compared, very striking differences may be secured, but I do deny that such comparison has any particular significance. For it neglects the fact that the extremes are always connected by intermediate forms whose existence makes separation a purely arbitrary matter. On the basis of the above considerations I have treated the eastern variants as synonyms of *imparis*.

The habits of *imparis* are interesting if not very spectacular. The colonies are small, seldom consisting of more than a few hundred individuals, and the nests are obscure. They are often built in damp soil and in shady positions. There is generally a single nest opening

around which excavated soil may be piled in the form of a tiny crater. More often, however, the excavated soil is dissipated by the weather as fast as it is brought to the surface. The workers of *imparis* feed upon various sorts of sugary liquids derived directly from plant sources or from aphids. They also feed on the juices of dead earthworms. They frequently assume a semireplete condition because of the amount of liquid taken into the crop. Their most interesting characteristic is a surprising tolerance for low temperatures. Workers of *imparis* have been observed feeding outside the nest when the temperature was only a few degrees above freezing. It might be supposed that this somewhat unusual capacity would make *imparis* an ideal species for life in subarctic areas. Actually its distribution is rather notably southern. The insect is rare in Canada, where it occurs only near the southern border, and it ranges into southern Mexico. It is true that the Mexican records are from mountainous regions but the elevations involved (7500′) seem far lower than would be expected of a boreal species. Wheeler has attempted to explain this curious distribution on the assumption that *imparis* was pushed southward by Pleistocene glaciation. This may be true but it will not explain why the insect has not reoccupied northern stations to which its tolerance for low temperature would seem to be ideally adapted.

Key to the subspecies of Prenolepis imparis Say

1. Crest of the petiole very distinctly concave, the concavity approximately two-thirds as wide as the greatest width of the scale..... *imparis* subsp. *arizonica*
   Crest of the petiole flat in the middle or if feebly concave the concavity is only about one-half as wide as the greatest width of the scale.....2
2. Basal face of the epinotum forming a right angle with the declivious face, the latter perpendicular or nearly so..... *imparis* subsp. *coloradensis*
   Basal face of the epinotum meeting the declivious face at a more obtuse angle, the declivious face sloping slightly to the rear.....3
3. The greatest diameter of the eye as long or a little longer than the space that separates the eye from the clypeal fossa..... *imparis*
   The greatest diameter of the eye slightly less than the distance which separates the eye from the clypeal fossa..... *imparis* subsp. *californica*

1. Prenolepis imparis (Say)

Formica imparis Say, Bost. Jour. Nat. Hist. Soc., Vol. 1, p. 278 (1836) ♀ ♂.
Prenolepis imparis Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 431 (1886); Emery, Zool. Jahrb. Syst., Vol. 7, p. 635 (1893) ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 390, fig. 1 (1905) ♂; Wheeler, Ann.

Ent. Soc. Amer., Vol. 23, p. 15, fig. 4 a (1930) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, pl. 20, fig. 77 (1947) ♀.

P. imparis var. *minuta* Emery, Zool. Jahrb. Syst., Vol. 7, p. 636 (1893) ♀ ♂; Wheeler, Ann. Ent. Soc. Amer., Vol. 23, p. 21 (1930) ♀ ♀ ♂.

P. imparis var. *testacea* Emery, Zool. Jahrb. Syst., Vol. 7, p. 636 (1893) ♀; Wheeler, Ann. Ent. Soc. Amer., Vol. 23, p. 21 (1930) ♀ ♀ ♂.

P. imparis pumila Wheeler, Ann. Ent. Soc. Amer., Vol. 23, p. 21 (1930) ♀ ♂.

P. nitens (part) Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 431 (1886).

P. nitens var. *americana* Forel in Grandidier, Hist. Nat. Madagascar, Vol. 20, 2, p. 94, pl. 3, fig. 4 (1891) ♂.

? *Formica* (*Tapinoma*) *wichita* Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 169 (1866) ♀.

? *Tapinoma polita* Fred. Smith, Trans. Ent. Soc. London, (2), Vol. 3, p. 112 (1855) ♀.

Type loc: Indiana. Types: none known to exist.

Range: New York and southern New England south to the end of the Appalachian Highlands and west to Wisconsin, Iowa and Missouri. The insect also occurs sporadically in southern Ontario and in the Gulf Coastal Plain.

For a discussion of the synonymy given above see the introduction to Prenolepis.

2. Prenolepis imparis arizonica Wheeler

P. imparis var. *arizonica* Wheeler, Ann. Ent. Soc. Amer., Vol. 23, p. 22 (1930) ♀ ♀ ♂.

Type loc: Ramsey Canyon, Huachuca Mts., Arizona. Types: M.C.Z.

Range: known only from the mountains of southern Arizona.

The type material of *arizonica* consisted of four workers, three males and a single female. It was difficult under such circumstances to evaluate the constancy of the definitive characteristics. In 1932 the writer took several colonies of *arizonica* in Ramsey Canyon. The broad petiole with its distinctly concave crest is quite constant in the worker. The sides of the head are almost straight and the thorax is stout, especially at the mesonotal 'waist'. There is every reason to suppose that *arizonica* is at least subspecifically distinct from *imparis* and it would not be surprising if this form subsequently proved to be a separate species.

3. Prenolepis imparis californica Wheeler

P. imparis var. *californica* Wheeler, Ann. Ent. Soc. Amer., Vol. 23, p. 23, fig. 4 b (1930) ♀ ♀ ♂.

Type loc: Stanford University, California. Types: A.M.N.H., M.C.Z.

Range: California, Oregon and western Nevada.

The variations in size and color which mark the subspecies *californica* are very suggestive of those which occur in the eastern *imparis*. It is to be hoped that no one will act on Wheeler's suggestion that names be given to these variants until it can be shown that more is involved than minor fluctuations of color and size.

4. Prenolepis imparis coloradensis Wheeler

P. imparis var. *coloradensis* Wheeler, Ann. Ent. Soc. Amer., Vol. 23, p. 22, fig. 4 c (1930) ♀.

Type loc: Cheyenne Mountain, Colorado Springs, Colorado. Types: A.M. N.H., M.C.Z.

Range: known from type material only.

Genus Lasius Fabricius

(Plate 53, figures 1–4)

Myrmecologists who have struggled with the tangled taxonomy of our representatives of Lasius may blame much of their difficulty on two entirely unrelated circumstances. The first is the notorious Erlangen List. The second is the exceedingly close relationship which exists between the Old and the New World forms of Lasius.

In 1935 the International Commission of Zoölogical Nomenclature suppressed the Erlangen List. This highly judicious decision put an end to the confusion regarding the validity of Lasius as an ant genus. It could not, unfortunately, suppress the evils which resulted from the proposal of Morice and Durrant to resuscitate Jurine's anonymous publication of 1801. It is seldom that a taxonomic paper strikes as many sparks as did that of Morice and Durrant. As far as ant taxonomy is concerned the only significant change was to make Lasius a homonym. To rectify this matter, they proposed to replace the name Lasius with Donisthorpea. The reaction was immediate and anything but complimentary. Wheeler, Emery and Forel all published caustic criticisms which must certainly have reddened several pairs of ears. But for a time these authorities could not arrive at any uniform treatment for Lasius and its subgenera. The only thing that they agreed upon was that they would not accept the name Donisthorpea on any grounds. In 1916 Emery had replaced Lasius with Shuckard's name Formicina, while Forel had resorted to Mayr's name Acanthomyops as a substitute. Wheeler, on the other hand, was more far-sighted. He refused to treat the Erlangen List as valid and continued to use the name Lasius. The effect of these changes on the internal

constitution of the genus was very unfortunate. There was a notable lack of agreement on subgeneric names at the very time when it was most needed. The distinctions between subgeneric groups have suffered in consequence. This is particularly true of Chthonolasius, which has been subjected to such a series of misunderstandings that it seems worth while to enumerate them here in the hope that further confusion may be prevented. In 1916 Wheeler proposed to sink Ruzsky's subgenus Chthonolasius as a synonym of Shuckard's Formicina. The type of the subgenus Formicina was to be *Lasius flavus*. In making this proposal Wheeler forgot that he had designated *Formica rufa* as the type of Formicina in 1912. He was also in error in supposing that Ruzsky had named *flavus* as the subgenotype of Chthonolasius. But the arrangement of species which Wheeler proposed to include in Formicina was a sound one. It embraced members of the *umbratus* complex and the *flavus* complex and other species allied to these two groups. Wheeler's error in regard to the type of Formicina was immediately detected by Donisthorpe and later Emery was able to show that Ruzsky had not designated any type for Chthonolasius. Emery supplied this omission by naming *umbratus* as the subgenotype of the group. But Emery would not agree to Wheeler's arrangement of species within Chthonolasius. Instead, he restricted the representation to species which have a relatively small female and a parasitic type of nest founding. As a result, *flavus* and the related species were returned to the subgenus Lasius. This produced structural heterogeneity in that subgenus, for *flavus* and its relatives are more closely related to Chthonolasius on the basis of structure. They possess a similar type of maxillary palp, in which the two terminal joints are shorter than the fourth joint, and their eyes are even smaller than those of *umbratus* and its allies. These inconsistencies have led most myrmecologists to treat the subgenus Chthonolasius as a more inclusive.group than that originally recognized by Emery. We have, in short, adopted Emery's proposal for the name of the subgenus but held to Wheeler's concept as to its constituent species. Thus, after more than a quarter of a century of confusion, the subgenera of Lasius appear to be regaining the nomenclatorial and structural stability which the Erlangen List destroyed.

The second difficulty presented by the taxonomy of Lasius results from the unusually close relationship of some of our representatives to forms which occur in Europe and Asia. In most cases when two related forms occur on opposite sides of the Atlantic they are distinguished by significant structural differences, although these may be of no great magnitude. In Lasius, however, the differences are often so slight that some of our representatives have been treated as varieties of

European forms. Indeed it is not too much to say that in certain cases the only thing that clearly separates the two forms is the Atlantic Ocean. This makes the taxonomy of Lasius singularly difficult to handle, for revisionary work on our forms cannot be undertaken without a consideration of the effect on the related European counterparts. The failure to do so is certain to produce awkward results.

A case in point is the admirably executed statistical study published by Mrs. E. V. Gregg in 1945. Mrs. Gregg clearly showed that *neoniger* and *americanus* cannot be regarded as representatives of the same species. To this conclusion there can be no possible objection. But it is quite another matter to accept Mrs. Gregg's proposal that each of these insects be considered a separate species. Mrs. Gregg did not prove that *neoniger* is specifically distinct from the Old World *niger* or that *americanus* is specifically distinct from the European *alienus*. The relationship of *neoniger* to *niger* and that of *americanus* to *alienus* cannot be explained by a comparison of *neoniger* with *americanus*. The best solution for the above situation seems to be to proceed one step at a time. If we recognize that *alienus* is specifically distinct from *niger*, a view which many myrmecologists have supported since the original description of *alienus* in 1850, we may then treat each American representative as a subspecies of its respective species without damage to the concepts of modern taxonomy or to the classical form of the science. But it seems to me that the proposal to treat *americanus* and *neoniger* as species in their own right is remarkably similar to the unsupported opinions of the older taxonomy which Mrs. Gregg is striving to modernize. I do not wish this to be construed as a criticism of an excellent piece of work which, in my opinion, should be continued and expanded. But the problem of Holarctic species is not one which is likely to be solved by disregarding the relationship between Old and New World forms. The range of *neoniger* extends well into British Columbia and southern Alaska. That of *niger* reaches eastern Siberia. It is by no means impossible that *neoniger* should be a subspecies of *niger*. Nor would it be surprising if a thorough analysis of the differences which are supposed to mark these two insects would show that they cannot be successfully separated.

The nest-founding habits of the ants of the genus Lasius fall into two main patterns. The ordinary claustral type of nest-founding is practiced by the representatives of the subgenus Lasius and the members of the *flavus* group in the subgenus Chthonolasius. All these insects have females whose size is notably greater than that of the worker. The species belonging to the *umbratus* group in Chthonolasius have females which are proportionally much smaller and these species behave as temporary social parasites when founding their nests. The

full details of the process are not yet known but Wheeler (1917) has given a very complete account of the manner in which the female of *subumbratus* gains access to the host nest of *neoniger*. The intruding female at first attempts to make friends with the *neoniger* workers but is usually repulsed by them. The *neoniger* workers may seize the appendages of the intruder but they do not press the attack and soon release her. The *subumbratus* female then hides in the *neoniger* nest and appropriates a part of the brood, over which she crouches until she has secured the *neoniger* nest odor. She is, thereafter, accepted without further difficulty by the *neoniger* workers. Nothing definite is known as to what becomes of the *neoniger* queen but it seems certain that she is eliminated, probably by the intruding female.

As far as is known, all our species of Lasius tend root coccids and aphids. In the case of some of the strongly hypogaeic species of Chthonolasius it is thought that these insects subsist mainly on the secretions of the coccids and aphids. Other species, particularly our two representatives of the subgenus Lasius, are more active in foraging above ground and supplement this diet with various foods. Most of the species of Lasius are remarkably flexible as to the types of nest sites which they will utilize, although most of them appear to prefer well drained soil that is not too dry. The nests may be free in the soil, under stones or other covering objects or in and under rotten logs and stumps.

Key to the species of Lasius

1. Maxillary palps long, the last three joints subequal in length; eyes large, about two hundred facets present (Subgenus *Lasius*) 2
   Maxillary palps short, the last three joints successively decreasing in length; eyes small, about one hundred facets present at most, usually many less present (Subgenus *Chthonolasius*) 3
2. Antennal scapes with numerous erect or suberect hairs; promesonotal suture slightly but distinctly impressed, the dorsum of the promesonotum not forming a single even convexity . . . . . *niger* subsp. *neoniger*
   Antennal scapes without erect or suberect hairs; promesonotal suture unimpressed or virtually so, the dorsum of the promesonotum forming a single even convexity . . . . . *alienus* subsp. *americanus*
3. Eyes with 10–12 facets in greatest diameter; females less than twice as long as the worker 6
   Eyes with six or less facets in greatest diameter; females more than twice as long as the worker 4
4. Scapes not reaching the occipital margin . . . . . *brevicornis*
   Scapes reaching or surpassing the occipital margin 5
5. Scapes reaching the occipital margin but not surpassing it . . . . . *flavus* subsp. *microps*
   Scapes surpassing the occipital margin . . . . . *flavus* subsp. *nearcticus*

6. Antennal scapes and tibiae with few or no erect hairs.....8
Antennal scapes and tibiae with abundant erect hairs.....7
7. Erect hairs forming a fringe on the crest of the petiole; gaster with abundant pubescence.....*pilosus*
Erect hairs on the crest of the petiole sparser and not forming a distinct fringe; gaster without pubescence, the surface strongly shining.....*speculiventris*
8. Length of the largest workers at least 4.5 mm.; gaster with sparse to moderately abundant pubescence and short erect hairs.....9
Length of the largest workers not more than 3.5 mm.; gaster densely pubescent with long erect hairs.....11
9. Gastric pubescence dilute, the surface rather strongly shining; eyes with not more than about sixty-five facets.....10
Gastric pubescence denser, the surface feebly shining; eyes with more than sixty-five facets.....*umbratus* subsp. *aphidicola*
10. Epinotum rounded; erect hairs absent or very sparse on the gula; color sordid brownish yellow.....*subumbratus* subsp. *epinotalis*
Epinotum angular; erect hairs abundant on the gula; color pale yellow..*subumbratus*
11. Mesonotum strongly convex; promesonotal suture distinctly impressed; length of female 4.5 mm.....*bicornis* subsp. *minutus*
Mesonotum moderately convex; promesonotal suture feebly impressed; length of female 3.5 mm.....*humilis*

Subgenus LASIUS Fabricius

1. LASIUS ALIENUS AMERICANUS Emery

L. niger var. *aliena* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 429 (1886) (*nec* Förster).

L. alienus Provancher, Addit. Faune Canada, Hym., p. 236 (1887) ♀ ♀ ♂; (*nec* Förster).

L. niger var. *americanus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 639 (1893) ♀ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 393 (1905).

L. niger subsp. *alienus* var. *americanus* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 525 (1917) ♀ ♀.

? *Formica pallitarsis* Provancher, Canadian Naturalist, Vol. 12, p. 355 (1881) ♀ ♂.

Type loc: no definite locality cited. - Types: none in this country.

Range: southern Canada and the whole of the United States with the exception of southern Florida, Texas and the more arid parts of the southwest.

The incidence of *americanus* seems to be higher in the eastern and central states than in the west. In the east it occurs in abundance as far south as Georgia and there are scattered records from northern

Florida. In the west the main range of *americanus* lies north of the latitude of Colorado, although there are scattered records from the mountains of New Mexico and Arizona. Its absence from Texas is rather puzzling, for there would seem to be no reason why it should not occur in the northeastern part of that state.

The reasons for treating *americanus* as a subspecies of *alienus* have been given in the introduction to the genus Lasius.

2. Lasius niger neoniger Emery

L. niger Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 429 (1886) (*nec* Linné).

L. niger var. *neoniger* Emery, Zool. Jahrb. Syst., Vol. 7, p. 639 (1893) ♀ ♀ ♂; Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 525 (1917) ♀ ♂.

L. niger subsp. *sitkaensis* Pergande, Proc. Wash. Acad. Sci., Vol. 2, p. 519 (1900) ♀.

L. niger var. *sitkaensis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 524 (1917) ♀ ♀ ♂.

L. niger subsp. *alienus* var. *americanus* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 614, pl. 21, fig. 79 (1944) ♀.

Type loc: no definite locality cited. Specimens bearing cotype labels and coming from Hill City, S. D. and Kittery Point, Maine are present in.the collections of the A.M.N.H. and the M.C.Z. In my opinion it is doubtful if any of the above specimens are actually types.

Range: southern Alaska, coast to coast in southern Canada and the northern United States. Southern extensions occur in the Appalachian Highlands, the Rockies and the California Sierras.

In the present work Pergande's *sitkaensis* has been treated as a synonym of *neoniger*. The differences of size and color which Wheeler cited as distinguishing characteristics seem to be without any taxonomic significance. The fact that the type specimens of *sitkaensis* came from Alaska has led to the impression that *sitkaensis* is a northern race while *neoniger* is a southern one. The large amount of distributional data which has been published for these two insects fails to support such a view. It is true that *neoniger* has not yet been reported from Alaska but except for this difference there is little to distinguish the ranges of the two forms. This is particularly noticeable in the mountains of the west, where one would certainly expect to find a significant elevational difference if the two insects were behaving as northern and southern races. Instead both forms occur in the same stations from sea level to elevations of 9000–10,000 feet. Finally, the two are inextricably connected by intermediate stages which occur in all parts of the range.

There has been so much stress placed upon the hairy antennal scapes as a distinguishing feature of *neoniger* that it seems worthwhile to mention that this is by no means the only difference which separates *neoniger* from *L. alienus americanus*. The sides of the head in *neoniger* are more nearly parallel so that there is less convergence at the insertion of the mandibles. This difference will hold regardless of the size of the worker. The thorax of *neoniger* is more bulky than that of *americanus*, with the promesonotal suture impressed enough to interrupt the even outline of the promesonotum when the thorax is viewed in profile. This condition is very clearly shown in the figure which Dr. Smith presented for *americanus* in his 1947 generic synopsis. I believe that I am correct in stating that the figure is actually taken from *neoniger*. For the promesonotal suture in *americanus* is usually unimpressed but if an impression is present it is never as deep as that shown in Dr. Smith's figure.

Subgenus CHTHONOLASIUS Ruzsky

3. LASIUS (CHTHONOLASIUS) BICORNIS MINUTUS Emery

L. umbratus var. *bicornis* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 430 (1886) (*nec* Förster).

L. umbratus subsp. *minutus* Emery, Zool. Jahrb. Syst., Vol. 7, p. 641 (1893) ♀ ♀ ♂; Wheeler, Psyche, Vol. 17, p. 241 (1910) ♀ ♀ ♂.

Type loc: New Jersey (by present restriction). Types: none in this country.

Host (temporary): *L. alienus americanus* ?

Range: northeastern United States.

4. LASIUS (CHTHONOLASIUS) BREVICORNIS Emery

L. brevicornis Emery, Zool. Jahrb. Syst., Vol. 7, p. 639, pl. 22, fig. 22 (1893) ♀ ♀ ♂.

Type loc: District of Columbia (by present restriction). Types: A.M.N.H., M.C.Z.

Range: eastern Canada south to the end of the Appalachian Highlands and west to the Rockies. The insect appears to be more abundant in the eastern part of its range than in the west.

The original clear distinction between *brevicornis* and *flavus nearcticus*, which was based upon scape length, has been confused by Wheeler's recognition of two other variants (*microps* and *claripennis*), which have a scape length intermediate between that of *brevicornis* and that of *nearcticus*. While it is still possible to separate *brevicornis*

on scape length, a more thorough study of this insect may show that the shape of the head is a sounder separatory character. The head of *brevicornis* appears to be wider and a little more quadrate than that of *nearcticus* but since the width of the head varies with the size of the worker it is difficult to use this difference in a key.

5. Lasius (Chthonolasius) flavus microps Wheeler

L. brevicornis subsp. *microps* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 526 (1917) ♀.

L. flavus subsp. *claripennis* Wheeler, Ibid., Vol. 52, p. 527 (1917) ♀ ♀ ♂.

Type loc: Camp Curry, Yosemite Village (4000 ft.), California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: Alberta south to Colorado and southwestward into California.

After considerable effort to discover significant differences which would enable the separation of *microps* and *claripennis*, the writer has reached the conclusion that both forms are the same western race of *flavus*. In view of the fact that the original description of each of these insects appeared on the same page of Wheeler's 1917 study of western ants, this conclusion is rather surprising. It is my opinion, however, that most of the differences noted by Wheeler result from the fact that he compared *microps* with *brevicornis* and *claripennis* with *flavus nearcticus*. If the two forms are compared with each other, it is quite another matter to arrive at significant differences. The eyes of some of the specimens of *claripennis* are a trifle larger and a little rounder than those of *microps* but there is no great uniformity in this characteristic. Nor does there seem to be any constant difference in color or pilosity. In both *microps* and *claripennis* the tips of the antennal scapes just reach the occipital margin. They are, therefore, slightly longer than those of *brevicornis* and slightly shorter than those of *flavus nearcticus*. For this reason it would be impossible, on the basis of scape length alone, to assign the forms to either of the above species with certainty. But the small eyes and less quadrate heads of the two seem to indicate a relationship with *flavus* rather than with *brevicornis*. I have, for the above reasons, treated *claripennis* as a synonym of *microps* and made the latter form a subspecies of *flavus*.

6. Lasius (Chthonolasius) flavus nearcticus Wheeler

L. flavus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 429 (1886); Emery, Zool. Jahrb. Syst., Vol. 7, p. 640 (1893) ♀ ♀ (*nec* Fabricius).

L. flavus subsp. *myops* Emery, Zool. Jahrb. Syst., Vol. 8, p. 334 (1894) (*nec* Forel).

L. myops Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 397 (1905) (*nec* Forel).
L. flavus var. *nearcticus* Wheeler, Psyche, Vol. 13, p. 39 (1906).
? *Formica ruficornis* Fabricius, Syst. Piez., p. 379 (1804); Roger, Berl. Ent. Zeitschr., Vol. 6, p. 285 (1862) ♀.
? *Formica mellea* Provancher, Natural Canad., Vol. 12, p. 356 (1861) ♀.
Type loc: Illinois (by present restriction). Types: M.C.Z.
Range: eastern Canada and New England through the northern United States to the Rocky Mountains with a southern extension which follows down the Appalachian Highlands.

In large workers of *nearcticus* the antennal scapes do not project as far beyond the occipital margin as they do in the smaller ones. For this reason it is often difficult to determine whether isolated specimens coming from the western end of the range of *nearcticus* belong to that subspecies or to the subspecies *microps*. With an adequate series of specimens there is usually little difficulty in deciding on the subspecies involved.

7. Lasius (Chthonolasius) humilis Wheeler

L. (*Formicina*) *humilis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 528 (1917) ♀ ♀.
Type loc: Pyramid Lake, Nevada. Types: M.C.Z.
Range: known from type material only.

8. Lasius (Chthonolasius) pilosus M. R. Smith

L. (*C.*) *pilosus* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 27, p. 384 (1934) ♀.
Type loc: Moscow, Idaho. Types: U.S.N.M., Coll. Dept. Ent. Univ. Idaho, Coll. M. R. Smith.
Range: known only from type material.

It seems very probable that *pilosus* is the worker of Wheeler's species *vestitus*. See discussion under that species.

9. Lasius (Chthonolasius) speculiventris Emery

L. speculiventris Emery, Zool. Jahrb. Syst., Vol. 7, p. 641 (1893) ♀ ♂.
L. umbratus subsp. *speculiventris* Wheeler, Psyche, Vol. 17, p. 242 (1910) ♀ ♂.
Type loc: Caldwell, New Jersey. Types: A.M.N.H., M.C.Z.
Range: New Jersey west to Illinois and south to the mountains of Tennessee.

Emery's treatment of *speculiventris* as a separate species is sounder than that proposed by Wheeler. It is impossible to consider *speculiventris* as a subspecies of *umbratus* as long as *aphidicola* is also assigned to that species. The range of *speculiventris* is coincidental with that of *aphidicola* over much of the eastern United States. I have restored *speculiventris* to its original specific status. Its very distinctive pilosity and pubescence certainly seem to warrant such a treatment and it may be wondered why Wheeler claimed in 1916 that it is scarcely more than a variety of *umbratus*.

10. Lasius (Chthonolasius) subumbratus Viereck

L. umbratus subsp. *subumbratus* Viereck, Trans. Ent. Soc. Phila., Vol. 29, p. 72 (1902) ♀; Wheeler, Psyche, Vol. 17, p. 237 (1910) ♀ ♀ ♂.
Type loc: Beulah, New Mexico. Types: A.N.S.P.
Host (temporary): *L. niger neoniger.*
Range: eastern Canada and northern New England and the Rocky Mountain Region. Also occurs in the mountains of Utah and Arizona.

Wheeler was inclined to treat *subumbratus* as a boreal race of *umbratus* but it seems to the writer that this may be doubted. Many of the western records which Wheeler cites clearly disprove his contention that the insect is confined to the Canadian Zone. These records (Boulder, Manitou, Colorado Springs in Colorado and Little Willow Canyon in Utah) seem to indicate that *subumbratus* is equally at home in the Transition Zone and to regard such a distribution as boreal is to strain the point still further. It may be noted that in many parts of the Rocky Mountain area *subumbratus* and *aphidicola* occur in the same stations and this also seems to be true of eastern Canada although the range of *aphidicola* extends much further to the south in the eastern United States. It seems best for this reason to accord full specific status to *subumbratus* and to treat the insect which Buren called *epinotalis* as a southern race of *subumbratus*.

11. Lasius (Chthonolasius) subumbratus epinotalis Buren

L. (*C.*) *umbratus* subsp. *epinotalis* Buren, Iowa State Coll. Jour. Sci., Vol. 18, p. 297 (1944) ♀.
Types: Coll W. F. Buren. Paratypes: U.S.N.M., Coll. Iowa State College, Coll. W. S. Creighton. Range: known from type material only.

Until more is known about the range of *epinotalis* its exact status is problematical. It would seem, however, that it is safe to say that

it cannot be treated as a subspecies of *umbratus* for it occurs in the same stations as *aphidicola*. Moreover the structure of *epinotalis* seems to indicate a closer relationship with *subumbratus* than with *aphidicola*. It may, however, subsequently prove to be a separate species.

12. Lasius (Chthonolasius) umbratus aphidicola (Walsh)

Formica aphidicola Walsh, Proc. Ent. Soc. Phila., p. 310 (1862) ♀ ♂.
L. aphidicola Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 429 (1886).
L. umbratus subsp. *mixtus* var. *aphidicola* Emery, Zool. Jahrb. Syst., Vol. 7, p. 640 (1893) ♀ ♀ ♂; Wheeler, Psyche, Vol. 17, p. 239 (1910) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 614, pl. 21, fig. 80 (1947) ♀.
Type loc: none cited, by inference Rock Island, Illinois. Types: A.N.S.P.?
Hosts (temporary): *L. alienus americanus*, *L. niger neoniger*, *L. flavus nearcticus*.
Range: Nova Scotia south to the end of the Appalachian Highlands and southwestward through Canada to the Rocky Mountains.

Although *aphidicola* has been treated here as a subspecies of *umbratus* it seems altogether likely that when this insect can be subjected to a careful comparison with the European subspecies *mixtus* the two will prove to be identical. In 1893 Emery expressed the opinion that *aphidicola* is no more than a color variety of *mixtus* and it may be added that the color difference which marks the two is remarkably slight. But whether *aphidicola* is a separate subspecies of *umbratus* or identical with the subspecies *mixtus*, the effect on the taxonomy of our other representatives would be the same. We can, therefore, without any hazard to future changes continue to use the name *aphidicola* until this can be shown to be a synonym of *mixtus*.

13. Lasius (Chthonolasius) vestitus Wheeler

L. umbratus subsp. *vestitus* Wheeler, Psyche, Vol. 17, p. 242 (1910) ♀.
Type loc: Moscow, Idaho. Type: M.C.Z.
Range: Idaho, Oregon and Washington.

The exact relationships of *vestitus* will not be clear until the worker and female are taken together. It seems plain enough that it should have separate specific status nonetheless. Wheeler believed that *vestitus* might be the female of either *speculiventris* or *pilosus*. It seems to the writer that the latter possibility is much more likely, not only because the two insects came from the same type locality, but also because they are much more similar as regards gastric pubescence and

erect pilosity. In either case the relationship is to a separate species. Hence there would seem to be little reason for continuing to treat *vestitus* as a subspecies of *umbratus*.

Genus ACANTHOMYOPS Mayr

(Plate 54, figures 1–4)

In the present work Acanthomyops has been accorded full generic status. Since the group has been treated as a subgenus of Lasius for the better part of a century, it may be felt that this change is ill-advised. Despite the sanction which time has conferred, I regard this change as both justifiable and imperative. It may be recalled that when Mayr reduced his own genus Acanthomyops to subgeneric rank in 1866, the other subgenera of Lasius had not been recognized. At that time Lasius was a decidedly protean genus, since it contained species which were later to be assigned to Melophorus (Lasiophanes) and Pseudolasius. Thus when Mayr included Acanthomyops in the genus Lasius he was not notably increasing the structural latitude of the group. It already contained species whose structure was fully as distinct as that of Acanthomyops, and Mayr's treatment could be justified on the grounds of consistency. It was not long, however, before Emery recognized the heterogeneous character of Lasius. In 1887 he established the genus Pseudolasius to receive certain species with three-jointed maxillary palps. Eight years later he removed other species to Melophorus. Why Emery did not restore generic rank to Acanthomyops is difficult to say. There is just as much justification for the generic status of Acanthomyops as there is for Pseudolasius. Indeed the two offer a remarkably close parallel, for both are mainly distinguished by their three-jointed maxillary palps. But Emery continued to treat Acanthomyops as a subgenus of Lasius, and for a while this treatment was marked by no inconsistency other than the one just mentioned.

This situation was altered when Ruzsky erected the subgenera Dendrolasius and Chthonolasius in 1913. It must not be thought that what follows is a criticism of these subgenera, for it is not so intended. If the structural differences which separate them from the typical subgenus Lasius intergrade, this does not affect their validity. The same thing may be said of most subgenera. But it is abundantly clear that these differences are not of the same magnitude as that which marks Acanthomyops. Ruzsky's subgenera are primarily based upon the proportions of the segments of the maxillary palps. The number of these segments has nothing to do witth he matter, since the max-

illary palps are six-jointed in all three subgenera. It is gratifying to note that these proportional differences hold unusually well and furnish a very satisfactory means by which the representatives of the three groups may be separated. But I do not see how anyone could take the view that the differences which separate Dendrolasius, Chthonolasius and Lasius are equal to that which characterizes Acanthomyops. Thus, as long as Acanthomyops is retained as a subgenus of Lasius, we have two grades of subgenera present, one marked by rather subtle differences of proportion in the palpal segments, the other distinguished by a very striking difference in the number of palpal segments. It would seem, therefore, that the recognition of Acanthomyops as a separate genus has two benefits. It relieves Lasius of structural heterogeneity and at the same time it puts the relationship of the remaining subgenera on a much more satisfactory basis.

The taxonomy of Acanthomyops presents few complications. The species are, for the most part, rather easy to distinguish and the group is notably free from synonyms and other taxonomic tangles. In the past much use has been made of the shape of the petiolar scale as a separatory character. There is no doubt that this feature is often very valuable in distinguishing between species but it is my opinion that the shape of the scale, particularly the presence or absence of a notch in its crest, is less constant than might be wished. For this reason I have used scape length instead in the accompanying key. I am ready to admit that this character has its faults also, for it is not always easy to determine the ratio of scape length to head length. But there seems to be very little variation in scape length within the species and, as already noted, this cannot always be said for the shape of the petiolar scale. In certain instances it is easier to recognize the species of Acanthomyops from the female than from the worker. Several of the females show striking and peculiar characters which are entirely lacking in the worker caste. The most outstanding example of this is, of course, the extraordinary β female of *latipes*. The number of these aberrant females is not, however, large enough to justify including female characters in the key. I have dealt with them under the species involved.

The habits of the species belonging to Acanthomyops are remarkably unobtrusive. Without exception these insects lead a largely subterranean existence. The nests are usually constructed under stones or logs or at the base of old stumps. Less often they are built in the soil without any covering object. In the latter case there is usually a low mound of excavated soil above the nest. During the marriage flight the workers come out of the nest in large numbers but this is the only time when they are easy to find above ground. Most of the

time they are underground, tending root aphids and coccids whose secretions are believed to make up the greater part of the food of these ants. All the species of Acanthomyops are marked by a characteristic odor which is like that of lemon verbena. Wheeler regards this as a 'nest odor' but it has been my experience that it is only produced when the ants are disturbed and it seems more in the nature of a repugnatorial character. It is particularly noticeable when the ants are crushed. Because of the peculiar structure of the females of some of the species, it is generally assumed that these species, and probably others as well, are temporary social parasites. As far as actual observation goes, however, we know practically nothing of the nest-founding activities of these insects.

Key to the species of Acanthomyops

1. Erect hairs on the thoracic dorsum with branching, plumose tips..... *plumopilosus*
   Erect hairs on the thoracic dorsum simple, often barbulate but the tips never plumose....2
2. The antennal scapes in repose surpassing the occipital margin by an amount at least as great as the thickness of the tip....3
   The antennal scapes in repose not surpassing the occipital margin, or if they do, the amount that projects beyond the margin is less than the thickness of the tip....6
3. Crest of the petiolar scale covered with very numerous, close-set, short hairs some of which arise from the front face of the scale thus giving the upper part of the scale a striking, brush-like appearance..... *murphyi*
   Crest of the petiolar scale with a few erect hairs which are arranged in a single row along the crest....4
4. Erect body hairs short and delicate; gastric pubescence dense, partly concealing and dulling the shining surface beneath..... *pubescens*
   Erect body hairs long and coarse; gastric pubescence very dilute, the gastric surface strongly shining....5
5. Clypeus with at least ten erect hairs present; eyes with 6–7 facets in greatest diameter..... *interjectus*
   Clypeus without erect hairs in most specimens, rarely two erect hairs present but never more; eyes with 8–9 facets in greatest diameter..... *interjectus* subsp. *arizonicus*
6. Fore femora without erect hairs or when these are present they are mainly confined to the flexor surface with only a few inconspicuous erect hairs at the base of the lateral face....7
   Fore femora with erect hairs occurring over much of the lateral face as well as on the flexor surface....9
7. The antennal scapes in repose not quite reaching the occipital margin...8
   The antennal scapes in repose slightly surpassing the occipital margin.. *parvula*

8. Scale of the petiole, in profile, high with a narrow and sharp crest which exceeds the level of the epinotal spiracle when the scale is in a vertical position; gastric pubescence dense ..... *occidentalis*
   Scale of the petiole, in profile, low with a rather blunt crest which does not reach the level of the epinotal spiracle when the scale is in a vertical position; gastric pubescence very dilute ..... *subglaber*
9. Scale of the petiole, in profile, with a blunt crest; seen from behind the crest is convex or flattened in the middle but never deeply notched. . *latipes*
   Scale of the petiole, in profile, with a thin, sharp crest; seen from behind the crest is usually deeply notched in the middle but at least there is a distinct median impression 10
10. Pubescence on the antennal scapes suberect over the entire scape..... *claviger* subsp. *coloradensis*
    Pubescence on the antennal scapes usually appressed over the entire surface but if suberect hairs are present, they are confined to an area near the tip of the scape 11
11. Eyes with 7–8 facets in greatest diameter; length 3.5–4 mm..... *claviger*
    Eyes with 5–6 facets in greatest diameter; length 2.6–3 mm..... *claviger* subsp. *californicus*

1. Acanthomyops claviger (Roger)

Formica claviger Roger, Berl. Ent. Zeitschr., Vol. 6, p. 241, pl. 1, fig. 13 (1862) ♀.
Acanthomyops claviger Mayr, Verh. Zool-bot. Ges. Wien, Vol. 12, p. 700 (1862) ♀.
L. (*Acanthomyops*) *claviger* Mayr, Ibid., Vol. 20, p. 950 (1870) ♀ ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 7, p. 642 (1893) ♀ ♀; Wheeler & McClendon, Biol. Bull., Vol. 4, p. 149, fig. 1–3 A (1903) ♀.
Type loc: Pennsylvania. Types: none in this country.
Range: southern New England west to the Rocky Mountains and south to Tennessee and North Carolina. The abundance of this insect seems to decrease sharply west of Wisconsin and Iowa. It is notably sporadic in the Rockies although it has been taken from Montana to northern New Mexico.

2. Acanthomyops claviger coloradensis (Wheeler)

Lasius (*A.*) *interjectus* subsp. *coloradensis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 532 (1917) ♀ ♀ ♂.
Type loc: Manitou, Colorado. Types: A.M.N.H., M.C.Z.
Range: widely distributed through Colorado but somewhat less abundant in northern New Mexico.

It is difficult to see why *coloradensis* was originally assigned to *interjectus* rather than to *claviger*. The female of *coloradensis* is a deep castaneous brown with a narrow petiole incised at the crest. The

worker lacks denticles on the basal border of the mandible, has comparatively short antennal scapes, an angular epinotum and abundant, erect body hair. All of the above characteristics accord better with those of *claviger* than with those of *interjectus*. I have, therefore, shifted *coloradensis* to *claviger* although I suspect that it will ultimately prove to be a separate species.

The nests of *coloradensis* are often situated on open intermountain plateaus where the only cover is that furnished by sage-brush bushes. It would appear to be more tolerant of drought than some of the other forms. Its elevational range also seems to be wider. I have taken it in central Colorado at elevations up to 8000 feet.

3. Acanthomyops claviger californicus (Wheeler)

Lasius (*A.*) *interjectus* subsp. *californicus* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 531 (1917) ♀ ♀.

Type loc: Palmer's Canyon, Claremont, California. Types: M.C.Z.

Range: known only from type material.

So little is known about *californicus* that nothing positive can be said about its distributional behavior or affinities. I have shifted it to *claviger* although I am by no means certain that this is the correct procedure. It does not, however, seem closely related to *interjectus*.

4. Acanthomyops interjectus (Mayr)

Lasius interjectus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 16, p. 888, pl. 20, fig. 3 (1866) ♀; Mayr, Ibid., Vol. 36, p. 430 (1886) ♀ ♀ ♂; Emery, Zool. Jahrb. Syst., Vol. 7, p. 642 (1893) ♀ ♀.

L. (*A.*) *interjectus* M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 610, pl. 20, fig. 78 (1947) ♀.

Formica flava Leidy, Proc. Acad. Nat. Sci. Phila., p. 145 (1877) ♀.

Type loc: New Jersey. Types: none in this country.

Range: coast to coast in the northern United States. In the west there is a southern extension to New Mexico in the Rocky Mountain Region and a similar southern extension follows down the Appalachian Highlands to the eastern Gulf States. The insect is abundant, however, only in the central and northeastern states.

The nests of *interjectus* are commonly found at the base of old rotten stumps although it will also nest under stones. More rarely it constructs nests in open soil without any covering object. The nests are usually situated in open woods or along the edges of meadows.

5. Acanthomyops interjectus arizonicus (Wheeler)

L. (*A.*) *interjectus* subsp. *arizonicus* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 532 (1917) ♀.

Type loc: Miller Canyon, Huachuca Mountains, Arizona. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.

Range: known only from the mountains of southern Arizona.

The most obvious difference between this subspecies and the typical *interjectus* is found in the notably sparser erect pilosity of *arizonicus*. This is most striking in the case of the gula, which is usually devoid of hairs in *arizonicus*, but the erect hairs are everywhere much sparser, with those on the gaster strictly confined to the rear edge of each segment except for a tuft at the base of the first segment.

6. Acanthomyops latipes (Walsh)

Formica latipes Walsh, Proc. Ent. Soc. Phila., Vol. 1, p. 311 (1862) ♀ ♀ ♂.

Lasius latipes Mayr, Verh. Zool-bot. Ges. Wien, Vol. 16, p. 889, pl. 20, fig. 4 (1886) ♀; Forel, Ann. Soc. Ent. Belg., Vol. 30, p. 209 (1886) ♀; E. André, Rev. d'Ent. Caen, Vol. 8, p. 220 (1889) ♀; Wheeler & McClendon, Biol. Bull., Vol. 4, p. 149, fig. 1–3 b, c (1903) α ♀, β ♀.

Type loc: no type locality cited, by inference Rock Island, Illinois. Types: none known to exist.

Range: coast to coast in the northern United States with southern extensions in the California Sierras and the Rockies. In the latter area the range reaches northern New Mexico. In the east the insect seems to be rare south of the latitude of Pennsylvania.

This species possesses two types of females. The more normal α type female has rather broad, laterally compressed femora and tibiae and distally incrassated antennal scapes. But these characters are greatly exaggerated in the β type female. In this extraordinary insect the femora and tibiae resemble flat plates with the tarsal joints so slender in contrast that they look like bits of dangling string. The scapes are very strongly incrassated distally and, since this incrassation gradually increases from base to tip, the scape presents the appearance of a slender cone. The insect is also unusually hairy.

7. Acanthomyops murphyi (Forel)

L. (*A.*) *murphii* Forel, Ann. Soc. Ent. Belg., Vol. 47, p. 367 (1901) ♀ ♀ ♂.

Type loc: Morgantown, North Carolina. Types: A.M.N.H.

Range: southern Ontario to the mountains of North Carolina and west to Montana and Colorado.

This species usually nests in open woods in the eastern states. In the west it often occurs in cottonwood groves near stream bottoms. The female of *murphyi* is scarcely less remarkable than the β type female of *latipes*. It has similar flattened femora and in addition a curious and distinctive beard-like mass of hairs on the clypeus and frontal lobes.

8. Acanthomyops occidentalis Wheeler

L. (*A.*) *occidentalis* Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 83 (1909) ♀ ♀ ♂.
Type loc: Colorado Springs, Colorado. Types: A.M.N.H., M.C.Z.
Range: southern Colorado and northern New Mexico.

I have retained Wheeler's name *occidentalis* because it appears that with Acanthomyops raised to generic rank the name is not any longer a homonym. In 1902 Wheeler agreed with Emery that Buckley's *Formica occidentalis* actually belonged to the genus Lasius. Emery had surmised that the species involved was *claviger* but Wheeler took the stand that Buckley's description would not permit specific recognition. There was, however, no further possibility of using the name *occidentalis* in the genus Lasius, hence Wheeler's choice of that name for the species which he described in 1909 was most unfortunate. It is odd that the homonym has stood for forty years without attracting attention. If Emery was correct that Buckley's species is *Acanthomyops claviger*, it would, of course, be necessary to replace Wheeler's name. In my opinion it is quite impossible to prove that Buckley's description can be assigned to Acanthomyops. In fact, it seems certain that it does not apply to *claviger*, for the length cited by Buckley for the worker is much too small. It seems to me that the best way out of this tangle is to regard Buckley's *occidentalis* as belonging to Lasius rather than to Acanthomyops. This frees Wheeler's name if Acanthomyops is given generic status. There would seem to have been a good deal of point to Forel's observation that Buckley's species are utterly unrecognizable and that no good purpose is served by trying to determine what they were.

9. Acanthomyops parvula (M. R. Smith)

L. (*A.*) *parvula* M. R. Smith, Psyche, Vol. 41, p. 213 (1934) ♀.
Type loc: Herrin, Illinois. Types: Coll. M. R. Smith.
Range: Illinois to Pennsylvania.

This species nests under rotten logs and beneath stones. *A. parvula* seems closely related to *subglaber*, from which it differs in its coarser

pilosity and slightly longer antennal scapes. The scapes slightly surpass the occipital border in all the specimens which I have examined. I believe that the color of *parvula* varies more than Dr. Smith supposed. Specimens of *parvula* taken by Mr. Brown near Philadelphia, Pa., have the head and thorax straw yellow with the gaster only a little paler. They are fully as dark as the paler specimens of *subglaber*.

10. Acanthomyops plumopilosus (Buren)

L. (*A.*) *plumopilosus* Buren, Iowa State Coll. Jour. Sci., Vol. 15, No. 3, p. 231, fig. 1 a–d (1941) ♀ ♀ ♂.
Type loc: Backbone State Park, Iowa. Types: U.S.N.M.
Paratypes: Coll. W. F. Buren, Coll. Iowa State College, Coll. W. S. Creighton.
Range: known from the type locality only.

The peculiar, plumose erect hairs which mark this species are present in all three castes, although less abundant in the male than in the female and worker. The female of *plumopilosus* is unusually small (4.6 mm.) and densely hairy. Buren believes that *plumopilosus* may be a temporary social parasite on *A. claviger*. This supposition was based on the fact that nests of *claviger* were present in the type locality of *plumopilosus*. While *plumopilosus* is probably a temporary social parasite, it seems unlikely that *claviger* is the host species.

11. Acanthomyops pubescens (Buren)

L. (*A.*) *pubescens* Buren, Iowa State Coll. Jour. Sci., Vol. 16, No. 3, p. 405 (1942) ♀ ♀.
Type loc: Jenkins, Minnesota. Types: U.S.N.M., Coll. Iowa State College, Coll. W. F. Buren, Coll. W. S. Creighton.
Range: known from type material only.

The types of *pubescens* were taken from a low mound nest in sandy soil in an open wood.

12. Acanthomyops subglaber (Emery)

Lasius claviger var. *subglaber* Emery, Zool. Jahrb. Syst., Vol. 7, p. 642 (1893) ♀ ♀ ♂.
L. (*A.*) *claviger* subsp. *subglaber* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 533 (1917).
L. (*A.*) *clavigeroides* Buren, Iowa State Coll. Jour. Sci., Vol. 16, No. 3, p. 406 (1942) ♀ ♀ ♂.

Type loc: Washington, D. C. Types: A.M.N.H., U.S.N.M.
Range: New England west to the Rocky Mountains and south through the Appalachian Highlands.

There is no doubt that *subglaber* is specifically distinct from *claviger*. In point of fact the two species have remarkably little in common. The size of *subglaber* is notably smaller in all three castes. It is far less pilose than *claviger* with the erect hairs delicate, short, and very sparse or absent on the front and gula. The latter parts are usually abundantly hairy in *claviger*. The petiolar scale in *subglaber* is slightly thicker than that of *claviger*, with the crest a little more blunt. The crest may be either flat in the middle or show a distinct notch. The color of *subglaber* is also rather variable. Some specimens are as deeply colored as *claviger*, others are a milky yellow. It is unfortunate that Buren, who was the first myrmecologist to recognize the insect as a separate species, failed to realize that it had been described before and gave it the synonymic name *clavigeroides*.

Genus MYRMECOCYSTUS Wesmael

(Plate 55, figures 1–4)

There are several circumstances which have made the taxonomy of Myrmecocystus much more difficult than it need have been. The genus is not overly complicated but it has been consistently subjected to unfortunate taxonomy. The two earliest descriptions of insects known to belong to the genus Myrmecocystus are those of Llave (1832) and Wesmael (1836). It may be doubted that either description could have been assigned to Myrmecocystus had not each author mentioned the presence of repletes. The types of Llave's *melligera* were lost; those of Wesmael's *mexieanus* remained unknown until 1893. As a result, there was a great deal of juggling with material belonging to Myrmecocystus during the latter part of the last century for it was largely a matter of personal preference as to whether specimens were assigned to *melligera* or *mexieanus*. The situation was by no means clarified when McCook sent specimens from Colorado to Forel in 1880. Forel pronounced these insects to be *melligera* or, as he preferred to call it, *melliger*. But McCook had the good judgement to give his specimens a new varietal name, *hortideorum*. It is plain that in 1880 Forel did not distinguish between *melliger* and *mexicanus* and it is safe to assume that the majority of his contemporaries were similarly confused. But in 1886 Forel redescribed *melliger* from material taken in Mexico and southern Texas. At this time Forel appreciated the

notable differences which separated his *melliger* from McCook's *hortideorum*. But since Forel was convinced that *melliger* and *mexicanus* were the same, he resolved the difficulty by setting up *hortideorum* as a separate species. Seven years later Emery secured a type specimen of *mexicanus* and showed that the differences which Forel had used to separate *hortideorum* were also present in *mexicanus*. But Emery added that while the insect which Forel had described as *melliger* is a separate species, it does not follow that it is the same insect that Llave had called *melligera*. On this account Forel was to be regarded as the author of *melliger* and Llave's species was to be regarded as unrecognizable. This observation had a profound effect on the taxonomy of Myrmecocystus and not, it must be confessed, an altogether good one. It was no longer difficult to distinguish between *melliger* and *mexicanus*. Instead it had become surprisingly simple to separate the two species. Additional material could be assigned to one or the other with ease and assurance. As a result, there grew up around each species a complex of subspecies and varieties, all of which showed the striking definitive characters of their respective prototypes. This practice presently began to involve some obvious discrepancies. Variants which had mandibles with seven teeth and whose eyes were small were made subspecies of *melliger*, although it was clear that they had little else in common with that species. The same thing happened in the case of *mexicanus*. It is hardly to be expected that European specialists could have avoided this difficulty. In most cases they were dealing with very limited series of cabinet specimens. But one might have hoped that Wheeler would have arrived at a different treatment. By 1908 he had made an extensive study of Myrmecocystus in the field and had accumulated a very large amount of material. Since Wheeler had dug up many colonies while looking for repletes he had unusually long series of specimens from stations which covered much of the southwestern United States. Wheeler presented a wealth of information on the biology of most of the forms. As will be subsequently shown, his findings revealed habits whose existence had not even been suspected. But as far as taxonomy was concerned, Wheeler adhered strictly to the practice of assigning all new variants to *melliger* or to *mexicanus*. Perhaps it was because he felt that these two species are so easy to distinguish that Wheeler presented no key to the group. But there were now thirteen named forms and it was not always easy to separate them from the descriptions only. In 1912 Wheeler published a second paper on Myrmecocystus which carried the descriptions of several new forms and also a key to the group. It is unfortunate that this key is so difficult to use. It is based to a surprising extent on slight differences in color and pilosity. Some of these dis-

tinctions are not only exceptionally subtle but they are based upon variable characters. Measurements of length are given as 'average' figures, a method which cannot be used with success for polymorphic species. Perhaps the most confusing feature is the fact that the key characters do not always check with those given by Wheeler in his earlier monograph. It is not surprising that most myrmecologists have left the taxonomy of Myrmecocystus severely alone. In 1936, however, Dr. A. C. Cole published the results of further studies on the genus. Dr. Cole has generously supplied me with type material of most of the forms which he described and it is very unpleasant to have to state that the majority are synonyms. This outcome was unavoidable, for Dr. Cole accepted Wheeler's key characters at their face value. As I have already shown these were not always reliable.

It seems to me that there is little hope for arriving at any satisfactory taxonomy for Myrmecocystus until it is realized that the differences which separate *melliger* and *mexicanus* are of more than specific significance. There is considerable justification for the view that these differences are of sufficient magnitude to warrant placing the two complexes in separate subgenera. I have not done so at the present time largely because we know so little about the typical *mexicanus*. When more material from Mexico is available for examination, and when the sexual phases of *mexicanus* are better known, it may be advisable to split Myrmecocystus into two subgenera. But it is not necessary to wait until this can be done to appreciate that many of the forms now treated as subspecies deserve full specific status. There is no justification, for example, in treating *semirufa* as a subspecies of *melliger*. The two insects differ notably in the degree of polymorphism of the worker caste, in size, in thoracic structure, in the character of the pilosity and pubescence and in habits. The only reason why *semirufa* has been assigned to *melliger* is because it has seven-toothed mandibles and small eyes. The same argument could be advanced for half a dozen 'subspecies' which have been assigned to that protean species. I have attempted to rectify these obvious inconsistencies in the present work and, in addition, I have ventured to give specific status to certain variants which are less obviously different. For I believe that two of Wheeler's varieties (*comatus* and *flaviceps*) are actually separate species.

It is a relief to turn from taxonomy to Wheeler's account of the habits of Myrmecocystus. The following observations are drawn almost entirely from his 1908 monograph with minor additions from the writer's own experiences in the field. The genus Myrmecocystus is marked by a strong preference for nest sites in dry regions. The nests are sometimes constructed in sand but more often they are built in

very stony, well-drained soil, which often bakes out to a consistency that makes it extremely difficult to excavate the nests. As a usual rule there is only one nest entrance around which soil and small pebbles will be thrown out. In some species this excavated soil is spread into a flattened disc, in others it forms a low crater. From the nest entrance a single passage descends through the soil. The length of this passage varies with the type of nest site and the species involved but it is seldom less than four inches or more than a foot in length. At its lower end it branches into several smaller passages and each of these leads to one of the nest chambers. The size of these chambers also varies with the species but they are rarely more than three or four inches long and perhaps an inch high. It may be added that those which the writer has seen were notably less regular than the much-republished figure which McCook originally presented. McCook's figure shows a chamber which has very much the shape of the inside of an igloo. These chambers have two uses. In certain cases they are partly filled with dead insects which the ants have collected. But their more spectacular use is that of a larder where certain members of the colony are slowly converted into living bags of honey. This astonishing transformation takes from one month to six weeks for completion. It begins while the prospective honey bag is still a callow, for once a worker has reached the stage where its integument has hardened it apparently cannot become a replete. It is not clear just when the incipient replete attaches itself to the roof of the chamber but for obvious reasons this must be fairly early in the process. Once it has done so it is constantly fed with honey by the other members of the colony. This honey is secured directly from plant exudates (oak galls) or from the secretions of aphids or coccids. The accumulation of honey in the crop of the incipient replete soon begins to distend the gaster. After a while the steadily expanding crop pushes the remaining viscera to one side and forces the gastric sclerites apart. Ultimately the intersegmental membranes are exposed and stretched to their maximum extent. The gaster is then about the size of a pea, translucent, and with the widely separated sclerites appearing like islands on its distended surface. In such a condition the replete is, of course, incapable of locomotion. It can hardly get its feet on the ground and if it can manage to do so the bulk of the gaster precludes movement. But, as Wheeler has shown, as long as the repletes retain their hold on the roof of the chamber they can shift about slightly. There is nothing to indicate which members of the colony will become repletes or to explain why the individuals which do become repletes behave as such. It seems significant, however, that in the strongly polymorphic species the major workers most often fulfill this func-

tion. From a practical point of view this seems thoroughly understandable, for a large worker would hold more honey than a small one.

It is to be expected that such remarkable reactions would be the subject of theories designed to explain them. Forel (1902) appears to have been the first myrmecologist to point out that the genera which regularly produce repletes always occur in dry environments. The case of Myrmecocystus in North America is parallelled by other genera which occur in the deserts of North Africa, Asia Minor and Australia. Forel's explanation of this fact was a simple one. He assumed that in the regions where such genera occur, the heat and drought of the summer months prevented the ants from leaving the nest. The replete was, therefore, a sort of a reservoir to be used during the period of aestivation. With this view Wheeler concurred in large part but he stressed the fact that the replete was produced only in times when an abundant supply of honey was available and that once the repletes had been produced there was no occasion for the other members of the colony to leave the nest until the supply of food stored in the repletes had been exhausted. Aestivation was, according to Wheeler an indirect rather than a direct effect of drought. But Wheeler was careful to point out that no amount of heat or drought would keep the ants in the nest if they lacked food. The significance of this last statement will be subsequently shown.

Forel had no first-hand knowledge of the habits of Myrmecocystus and could not elaborate his hypothesis. Wheeler, however, was able to add a number of qualifications. He pointed out that, after much effort, he had been unable to discover any evidence that repletes were produced in the nests of *orbiceps*, *mendax*, *comatus*, *mimicus*, *semirufa* or *navajo*. Instead of feeding on honey, these ants fed mainly on other insects. This was a wholly new concept for, following McCook's celebrated account of the habits of *hortideorum*, it had been assumed that all the members of Myrmecocystus behaved in essentially the same way. The importance of Wheeler's findings cannot be minimized, but it may be submitted that he allowed himself to be unduly influenced by them. Although Wheeler admitted that these insects might have habits sufficiently flexible to permit them to feed upon both honey and insects, he preferred the view that their diet is specific. It is interesting to note that three years later (1911) Leonard proved conclusively that *mexicanus* produces repletes while feeding upon both honey and insects. But Wheeler did not know of any such case in 1908 and he proceeded to elaborate the concept that certain forms of Myrmecocystus feed exclusively on honey and produce repletes while others feed only on insects and cannot do so. Thus what Wheeler called the 'replete habit' was given a quasi-taxonomic char-

acter, for as long as Wheeler was convinced that the 'insectivorous' forms cannot produce repletes, he could use this distinction to separate them from other forms which are able to do so. As I have shown elsewhere, this concept had a strong effect on Wheeler's taxonomic treatment of Myrmecocystus.

In his effort to establish this view as securely as possible, Wheeler presented some very pertinent observations on the conditions necessary for replete formation. In order for repletes to be produced there must be an abundant supply of honey, at least during the time when callows are present in the nest. In the case of the deserticolous species, Wheeler pointed out that it is extremely unlikely that the sparse and desiccated desert vegetation could supply enough honey at the critical period and that aphids and coccids, which might be used to augment the honey flow, are usually rare in deserts. Conversely Wheeler observed that with *hortideorum*, in whose nests repletes are regularly produced, the less xerophytic character of the environment ensures an abundant and prolonged supply of honey. Since *hortideorum* nests in areas where shin oaks grow, it can utilize the honey droplets produced on the surface of the oak galls over a long season and it would undoubtedly have abundant honey at hand when callows are present in the nest.

It would seem that while Wheeler did not manage to establish his own theory, he completely destroyed Forel's view as to the significance of replete production. It is clear that the production of repletes is not a simple response to an arid climate. It is further clear that aestivation has nothing to do with it, for the reason that aestivation does not occur. Both Wheeler and McCook have shown that workers of *hortideorum* are active in gathering honey during the months of July and August, the very time that they should be aestivating in the nest if they ever do so. The fact that the insects forage for honey only at night may be a response to an arid climate but this is certainly a long way from aestivation. This midsummer foraging is characteristic of all the species which the writer has been able to observe in the field. At times it is exceedingly striking. In the summer of 1933 we were collecting in the Big Bend area in Texas in the middle of July. It was claimed that no rain had fallen in this area for the previous eighteen months. The prolonged drought had caused extensive aestivation of many ants in the shady canyons of the Chisos Mountains. The colonies had frequently dug in to such an extent that the only specimens which could be secured were dead workers in the upper nest passages. Yet on the open desert about fifty miles south of Marathon, workers of *mimicus* were actively foraging. We may, I believe, doubt that any species of Myrmecocystus aestivates during the summer months.

This calls for a revaluation of the status of the replete. It appears that the production of repletes is not a response to the rigors of desert life but a phenomenon which results when a xerophilous species adapts itself to a less rigorous environment. We may suppose that the tendency to store food in the nest, a characteristic frequently met with in xerophilous genera, has remained under conditions which make this behavior unnecessary. There would seem to be no reason why honey should be stored in the nest when it is produced, as seems to be the case, over the entire summer season. Thus the replete may be regarded as the victim of a life that is too easy, a view that accords well with their rather morbid character. Conversely, the failure of the desert-dwelling species to produce repletes can scarcely be taken as an indication of their inability to do so. It seems much more likely that the absence of repletes in their nests is the outcome of the fact that they do not get enough honey at the critical period when callows are present. Since we know that *semirufa* and *comatus* will feed on honey when they can get it, we may suppose that the other 'insectivorous' species behave in the same fashion. These considerations make it difficult to agree completely with Wheeler that the capacity for producing repletes, or the lack of it, is a specific character. It must, of course, be recognized that in certain species the production of repletes has become a regular feature in the life of the colony and to this extent the character is specific. But I fail to see that the reverse situation has an equal significance. The fact that a species lacks repletes is not a proof that it also lacks the capacity for producing them. Until it can be shown that this latter condition obtains there is little justification for regarding the lack of repletes as a specific character.

The key which follows does not contain Forel's *depilis* or Cole's *californicus*. It is possible that *depilis* is the same as Wheeler's *mimicus* and if this can be proven Forel's name will have to take precedence. But it seems impossible to determine what *depilis* is without an examination of the entire type series. The cotype of *depilis* which Forel sent to Wheeler does not accord in important respects with Forel's description and the chances are that the type series of *depilis* is mixed. Because of the uncertainty as to the exact nature of *depilis* there is no way of knowing whether this insect occurs in the United States or not. I regard the specimens which Wheeler assigned to it as belonging to *mimicus*. I have seen no material referable to *californicus* and have been unable to place it in the key from Cole's description.

Key to the species of Myrmecocystus

1. Mandibles with 9 teeth; eyes large, their greatest diameter notably longer than the length of the first funicular joint; ocelli always small, usually

obscure and often absent....2
Mandibles with 7 teeth; eyes small, their greatest diameter approximately equal to the length of the first funicular joint; ocelli always present, large and prominent....5

2. Erect hairs on the crest and sides of the petiole fairly numerous and conspicuous; scale of petiole thick from front to back; worker caste strongly polymorphic, 4.5–9 mm. in length....3
Scale of the petiole usually hairless, at most with one or two fine, inconspicuous erect hairs; scale thin from front to back; worker caste feebly polymorphic, 3–5 mm. in length....4

3. Head and thorax reddish or brownish yellow, gaster piceous brown, much deeper in color than the head and thorax....*mexicanus*
Head and thorax clear yellow to milky yellow, gaster usually little darker than the head and thorax and never piceous....*mexicanus* subsp. *hortideorum*

4. Impression at the mesoepinotal suture pronounced, the epinotum sharply set off from the mesonotum and with its basal face distinctly higher than the suture which bounds its anterior edge; the rear border of the eyes coinciding with the occipital angles of the head....*navajo*
Mesoepinotal suture not impressed, the epinotum not sharply set off from the mesonotum, its basal face passing without an interruption to the mesonotum; the rear border of the eyes lying a little ahead of the occipital angles....*mojave*

5. Gula broadly concave; node of the petiole strongly compressed from front to back, the crest thin and often with a median concave impression; color uniform deep brownish black....6
Gula flat or broadly convex; node of the petiole thick from front to back, the crest blunt, usually unimpressed; color not as described above....7

6. Antennal scapes without erect hairs....*lugubris*
Antennal scapes with erect hairs....*hammettensis*

7. Erect hairs delicate, at most moderately abundant, sparse or absent on the cheeks, those on the gaster arising from indistinct punctures; pubescence short and dilute, not notably obscuring the surface beneath; head, thorax and gaster moderately shining....8
Erect hairs coarse and very numerous, abundant and conspicuous on the cheeks, those on the gaster arising from punctures at the top of small conical papillae; pubescence dense, largely obscuring the surface beneath, the insect often silvery but not particularly shining....11

8. Femora and tibiae with few erect hairs, those present mainly confined to the flexor surfaces; length 2.5–3.5 mm....9
Femora and tibiae with abundant erect hairs on all surfaces; length greater than 3.5 mm....10

9. Head broader behind than in front; color dark brown, the front of the head not yellow....*yuma*
Head about as broad in front as behind; color pale brown, the front of the head yellow....*flaviceps*

10. Promesonotum in profile rising sharply above the level of the epinotum,

the basal face of the epinotum well below the level of the anterior edge of the pronotum; head and thorax clear yellowish red, gaster brownish black; length 3–4.5 mm..... *semirufa*
Promesonotum in profile not rising sharply above the level of the epinotum the basal face of the epinotum on approximately the same level as the anterior edge of the pronotum; color variable but seldom as light as that described above; length 3–6 mm..... *mimicus*

11. Scale of the petiole not higher than its greatest thickness from front to back, not reaching the level of the epinotal spiracle when in a vertical position; crest of the scale blunt but angular, not evenly rounded above; erect hairs all of about the same length..... *mendax*
Scale of the petiole higher than its greatest thickness from front to back, reaching or slightly exceeding the level of the epinotal spiracle when in a vertical position; crest of the scale blunt and evenly rounded above; erect hairs very uneven in length..... 12

12. Some of the erect hairs on the thorax fully as long as those on the occiput; head of the large worker with straight or feebly convex sides; length 4.5–7 mm..... *comatus*
Erect hairs on the thorax notably shorter than those on the occiput; head of the large worker with strongly convex sides; length 4.5–9 mm..... 13

13. Large workers with orbicular heads not present in the colony.... *melliger*
Large workers with orbicular heads present in the colony..... *melliger* subsp. *orbiceps*

1. Myrmecocystus comatus Wheeler

M. melliger subsp. *mendax* var. *comatus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 352, fig. 5 (1908) ☿ ♀ ♂; Wheeler, Psyche, Vol. 19, p. 173 (1912) ☿.

Type loc: Ft. Davis, Texas. Types: A.M.N.H., M.C.Z.

Range: mountains of western Texas west to those of southern Arizona.

There seems to be no reason why this very distinct species should have been treated originally as a variety of *mendax*. It has nothing in common with *mendax* either as regards pilosity or the structure of the petiole. In petiolar structure *comatus* is much more like *melliger* but differs from that species in its smaller size and longer and more abundant hair. The name *comatus* is very appropriate, for there is no other species in the genus which is quite so hairy. The color of *comatus*, which is darker than that of *melliger*, seems to be rather constant. The thorax is extensively infuscated, with only a part of the mesonotum and the pronotum ferrugineous in the larger specimens. The thorax of the smaller workers is usually entirely infuscated but the head is ferrugineous in all workers regardless of size. The species has so far been taken only at moderate elevations in hilly country or in the foothills of mountains. It apparently does not nest in the open desert.

2. Myrmecocystus flaviceps Wheeler

M. yuma var. *flaviceps* Wheeler, Psyche, Vol. 19, p. 177 (1912) ♀.
Type loc: Yuma, Arizona. Types: A.M.N.H., M.C.Z.
Range: known only from type material.

The differences which separate *flaviceps* from *yuma* are certainly distinct enough to warrant specific status for the insect. Moreover *flaviceps* cannot be considered an infraspecific variant of *yuma* since both occur, without intergrading, in the same area. According to Wheeler the craters made by *flaviceps* are about twice as large as those of *yuma* (6–8 inches in diameter) and the colonies of *flaviceps* are more populous. The insect nests in gravelly soil in deserts.

3. Myrmecocystus hammettensis Cole

M. hammettensis Cole, Amer. Mid. Naturalist, Vol. 19, No. 3, p. 678 (1938) ♀ ♀ ♂.
Type loc: Hammett, Idaho. Types: Coll. A. C. Cole.
Paratypes: A.M.N.H., Colls. Kennedy, Weber, Mallis, Creighton.
Range: known only from the type locality.

According to Cole this species constructs small craters of sand which are from 3–6 inches in diameter. The nests were situated on a sagebrush flat. It appears that the type locality of *hammettensis* is the northernmost record for the genus Myrmecocystus. The village of Hammett is approximately on Lat 43°, an astonishing station for a member of a genus which is so predominantly southwestern in its distribution. When more material is available for examination *hammettensis* may prove to be a northern race of *lugubris*. The two insects are very similar and it seems worth noting that at least some of the types of *hammettensis* have the same slight impression in the crest of the petiole which marks *lugubris*. The antennal scapes of *hammettensis* are covered with erect hairs and, since these are lacking in *lugubris*, it is easy to separate the two species.

4. Myrmecocystus lugubris Wheeler

M. lugubris Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 98 (1909) ♀; Wheeler, Psyche, Vol. 19, p. 176 (1912) ♀.
Type loc: Otis, California. Types: A.M.N.H., M.C.Z.
Range: known from type material only.

Very little is known about the habits of *lugubris*. The type locality is in the Mojave Desert and two of the types were semirepletes. The habits of *lugubris* should, therefore, prove of much interest for, as has been shown on a previous page, it is only rarely that repletes are produced in the nests of the desert-dwelling species.

5. Myrmecocystus melliger Forel

M. melliger Forel, Ann. Soc. Ent. Belg., Vol. 30, p. 202 (1886) ♀; Emery, Zool. Jahrb. Syst., Vol. 7, p. 666 (1893); Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 348, fig. 2 (1908) ♀; Wheeler, Psyche, Vol. 19, p. 175 (1912) ♀ ♀ ♂.

? *Formica melligera* Llave, Reg. Trim. o Collect. Mem. Hist. Lit., p. 463 (1832) ♀.

Type loc: Mexico. Types: none in this country.

Range: sporadically along the southern boundary of the United States from Texas to Arizona and south into Mexico, where it appears to be much more abundant.

The status of *melliger* has never been overly satisfactory and Wheeler's description of *orbiceps* did nothing to improve it. Although Wheeler presented a difference in pubescence which is supposed to separate the two, this difference is, in my opinion, entirely without value. Thus the only way in which *melliger* can be certainly separated from *orbiceps* is to have a replete of *melliger* or one of the workers of *orbiceps* which has a strongly orbicular head. If Wheeler is correct, *melliger* does not produce workers of this type, nor does *orbiceps* produce repletes. Since both the replete and the worker with a strongly orbicular head make up a small part of the colony, it follows that neither is likely to be represented in a series of specimens unless very thorough collecting methods have been employed. Hence much of the material of *melliger* and *orbiceps* cannot be separated. In the opinion of the writer this need cause no particular concern, for it seems very likely that *orbiceps* is a synonym of *melliger*. It is my conviction that a better knowledge of *melliger* will show that it also produces workers with orbicular heads. This view is based on the fact that much of the material identified by Wheeler as *orbiceps* fails to show the almost circular head which is supposed to characterize that form. It should be remembered that *melliger* has a large worker in which the sides of the head are strongly convex, hence the difference involved is less pronounced than might be supposed. In my opinion, a good part of the material identified as *orbiceps* by Wheeler might, with equal propriety, have been assigned to *melliger*. The principal reason

why Wheeler placed this material with *orbiceps* seems to have been that he could not find repletes in the nest. I have no doubt that sooner or later a nest will be found which contains both repletes and workers with strongly orbicular heads. It will then be possible to put an end to what is now an annoying and insoluble problem.

6. Myrmecocystus melliger californicus Cole

M. melliger subsp. *californicus* Cole, Ent. News, Vol. 47, No. 5, p. 118 (1936) ♀.
Type loc: Weed, California. Types: Coll. Cole. Paratypes: U.S.N.M., Coll. Kennedy.
Range: known from type material only.

7. Myrmecocystus melliger orbiceps Wheeler

M. melliger subsp. *orbiceps* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 349, fig. 3 (1908) ♀ ♀; Wheeler, Psyche, Vol. 19, p. 173 (1912) ♀.
Type loc: Bull Creek, Austin, Texas. Types: A.M.N.H., M.C.Z.
Range: western Texas to southern Arizona.

As has already been shown this subspecies is, in all probability, a synonym of *melliger*. Since all the records of *orbiceps* come from the United States and most of those of *melliger* from Mexico, it is possible to treat *orbiceps* as a northern race of *melliger* until its status can be more fully determined.

8. Myrmecocystus mendax Wheeler

M. melliger subsp. *mendax* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 351, fig. 4 (1908) ♀ ♀ ♂; Wheeler, Psyche, Vol. 19, p. 173 (1912) ♀.
Type loc: Mt. Washington, near Colorado Springs, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: southern Colorado, New Mexico and Arizona in the foot hills of low mountain ranges.

The low and very thick petiole of *mendax* distinguishes it from any other species. In this connection it seems worth noting that Wheeler's figure of *mendax* shows the scale of the petiole much higher than it actually is. The crest of the scale is flatter, more angular and less rounded than that of the figure. The nests of this species which the writer has been able to examine were built in very stony soil. There was no definite crater, although considerable loose soil had been thrown out around the nest entrance. The insect is less xerophilous than some of the other species of Myrmecocystus and appears to prefer nest sites similar to those selected by *hortideorum*.

9. Myrmecocystus mexicanus Wesmael

M. mexicanus Wesmael, Bull. Acad. Sci. Belg., Vol. 5, p. 766 (1838) ♀ ; Emery, Zool. Jahrb. Syst., Vol. 7, p. 666 (1893) ♀ ; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 356 (1908) ♀ ; Wheeler, Psyche, Vol. 19, p. 173 (1912) ♀ ; Emery, in Wytsman, *Genera Insectorum*, Fasc. 183, pl. 4, fig. 7 (1925) ♂.

? *Formica melligera* Llave, Reg. Trim. o Collect. Mem. Hist. Lit., p. 463 (1832) ♀.

Type loc: Mexico. Types: none in this country.

Range: southern Arizona and southern California south into Mexico.

An interesting account of the habits of this species was presented by Leonard in 1911. He found that *mexicanus* is pleometrotic, that the semirepletes move about freely in the nest and that the larvae are fed, at least in part, on dead insects. In some of the nest chambers there were repletes suspended from the ceiling and larvae lying on the floor. It is also noteworthy that Leonard found that *mexicanus* prefers nest sites that are by no means arid. On a previous page I have attempted to show that replete production might be expected only in case of the less xerophilous species.

10. Myrmecocystus mexicanus hortideorum McCook

M. melliger Forel, Aertzl. Intelligenzbl. München, Vol. 27, p. 32 (1880) (*nec melliger* Forel 1886).

M. melliger var. *hortus-deorum* McCook, Proc. Acad. Nat. Sci. Phila., p. 75 (1881) ♀ ; McCook, Honey Ants, Garden of the Gods, Lippincott & Company, Phila., p. 75 (1882) ♀ ♀ ♂.

M. hortus-deorum Forel, Ann. Soc. Ent. Belg., Vol. 30, p. 202 (1886) ♀ ♀ ♂.

M. mexicanus var. *hortideorum* Emery, Zool. Jahrb. Syst., Vol. 7, p. 666 (1893) ♀ ; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 359, figs. 6–10 (1908) ♀ ♀ ♂; Wheeler, Psyche, Vol. 19, p. 173 (1912) ♀ ; Emery in Wytsman *Genera Insectorum*, Fasc. 183, pl. 4, fig. 5 (1925) ♀.

Type loc: Manitou, Colorado. Types: none known to exist.

Range: the southern parts of Colorado and Utah south into New Mexico and Arizona.

For a discussion of the habits of *hortideorum* see the introduction to Myrmecocystus.

11. Myrmecocystus mimicus Wheeler

M. melliger subsp. *mimicus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 353 (1908) ♀ ♀ ♂; Wheeler, Psyche, Vol. 19, p. 174 (1912) ♀.

M. melliger subsp. *mimicus* var. *jesuita* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 354 (1908) ♀; Wheeler, Psyche, Vol. 19, p. 174 (1912) ♀.
M. melliger subsp. *lomaensis* Wheeler, Psyche, Vol. 19, p. 175 (1912) ♀ ♀.
M. melliger subsp. *semirufus* var. *romainei* Cole, Ent. News, Vol. 47, No. 5, p. 120 (1936) ♀.
Type loc: Albuquerque, New Mexico. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: desert areas from western Texas to southern California.

The color of *mimicus* varies considerably and the pattern of the erect hairs is far from constant. In a single nest series the pilosity of some specimens may be rather short and very uniform in length while that of other individuals will be uneven in length with some of the hairs quite long. Despite these differences, the erect hairs of *mimicus* are always delicate and they never are as numerous as those of *melliger*, *comatus* etc. I have noted elsewhere that *mimicus* may be a synonym of *depilis*. At present it seems impossible to settle this problem but much can be done to improve the taxonomy of *mimicus*. The forms *romainei*, *jesuita* and *lomaensis* are, in my opinion, all synonyms of *mimicus*. Cole's *romainei* is identical with the type of *mimicus* but the other two forms differ in minor details which ought to be considered, although they have no taxonomic significance. The variety *jesuita* was established on the rather remarkable basis that its color was more variable than that of *mimicus*. Thus *jesuita* showed individuals lighter than *mimicus*, others darker than *mimicus* and, although Wheeler avoided mention of this, still others exactly like those of *mimicus*. As a result, it is quite impossible to secure any satisfactory separation between *jesuita* and *mimicus*, a fact which Wheeler clearly understood, as is shown by his mention of color variation and intergrades in the material which he assigned to *mimicus*. The only thing which the description of *jesuita* signifies is that the color in some colonies of *mimicus* varies more widely than it does in others. It is astonishing that Wheeler should ever have given a varietal name to *jesuita*. His treatment of *lomaensis* is scarcely less remarkable. Wheeler attempted to separate *lomaensis* from *mimicus* on the basis of its darker color, its less abundant erect pilosity and a wedge-shaped petiole in which the summit is more compressed from front to back. In addition, the wings of the female were said to be longer. From what has just been said about *mimicus*, it should be clear that the distinctions based upon color and pilosity mean nothing. The petiolar difference cited by Wheeler does not exist and is, in my opinion, a result of the fact that Wheeler first compared *lomaensis* with *melliger*. The petiole of *lomaensis* differs from that of *melliger* as Wheeler says it does, but this same difference is also true of the petiole of *mimicus*.

Wheeler's distinction between *lomaensis* and *melliger* will not, therefore, separate *lomaensis* from *mimicus*. The only structural difference between *lomaensis* and *mimicus* is the greater length of the wings of the female in the first form. I see no reason to attach any significance to a character which is so apt to vary. It is not difficult to supply a reason why Wheeler was so anxious to separate *lomaensis* from *mimicus*. As has been explained on a previous page, Wheeler believed that *mimicus* could not produce repletes. These had been found in the nests of *lomaensis*. As a result Wheeler was faced with the choice of abandoning his theory as to the 'insectivorous' forms of Myrmecocystus or establishing *lomaensis* as a separate form. He took the latter course, but this means that the real basis for the recognition of *lomaensis* is not a structural one but the fact that it produces repletes. Since I cannot agree with Wheeler's view of specificity in the diet of Myrmecocystus, this fact is not, in my opinion, of any separatory value.

12. Myrmecocystus mojave Wheeler

M. mexicanus subsp. *mojave* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 360 (1908) ☿ ; Wheeler, Psyche, Vol. 19, p. 173, 179, fig. 1 (1912) ☿ ♀ ♂.
M. mexicanum subsp. *idahoensis* Cole, Ent. News, Vol. 47, No. 5, p. 118 (1936) ☿ ♀ ♂.
Type loc: Ontario, California. Types: A.M.N.H., M.C.Z.
Range: southern California northwestward to southern Idaho.

Although Cole's *idahoensis* has proven to be a synonym of *mojave*, his discovery of this species in southern Idaho is of much interest. It greatly extends the range of *mojave*, which was previously known only from southern California. The wide difference in the range of the two forms would lead one to expect that *idahoensis* is a northern race. But after much effort to arrive at separatory characters which might be used to give *idahoensis* subspecific status, I have had to give up this view and conclude that *mojave* does not vary appreciably over its whole range, which must include most of the Great Basin Region.

It seems worth noting that the antennal scapes in *mojave* are not always covered with erect hairs on all surfaces. Specimens are often encountered in which the hairs are limited to the front face of the scape as in *navajo*. The two species can be readily separated because of the very different epinotal structure and the difference in the position of of the eyes. It is more difficult to use the characteristics of proportion in the head and pronotum cited by Wheeler for, while such differences exist, they are affected by the size of the worker and, unless one compares workers of identical size, there is a chance for confusion.

Leonard has shown that the habits of this species are very much like those of *hortideorum*. The insect forages only at night, produces repletes and feeds upon honey and other insects. It will, during especially hot weather, sometimes remain in the nest for several days. As far as I have been able to determine, this is the only published observation on the 'aestivation' of any of these species.

13. Myrmecocystus navajo Wheeler

M. mexicanus subsp. *navajo* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 360, fig. 11 (1908) ♀ ♀; Wheeler, Psyche, Vol. 19, p. 173 (1912) ♀.
Type loc: Albuquerque, New Mexico. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known from New Mexico only.

This small species makes obscure nests in sandy soil. It does not construct a crater but spreads the excavated soil out into a disc. It undoubtedly produces repletes but Wheeler was unable to discover any in the twenty-two nests which he excavated in 1908.

14. Myrmecocystus semirufa Emery

M. melliger var. *semirufa* Emery, Zool. Jahrb. Syst., Vol. 7, p. 667 (1893) ♀ ♂.
M. melliger subsp. *semirufus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 355 (1908) ♀; Wheeler, Psyche, Vol. 19, p. 174 (1912) ♀.
M. melliger var. *testacea* Emery, Zool. Jahrb. Syst., Vol. 7, p. 667 (1893) ♀.
M. melliger subsp. *semirufa* var. *testacea* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 355 (1908) ♀; Wheeler, Psyche, Vol. 19, p. 174 (1912) ♀.
M. melliger subsp. *semirufa* var. *kennedyi* Cole, Ent. News, Vol. 47, No. 5, p. 119 (1936) ♀ ♀ ♂.
Type loc: Denver, Colorado. Types: A.M.N.H.
Range: New Mexico and Colorado west to California and northwestward through the Great Basin Region to the deserts of southern Idaho and eastern Oregon.

The tolerance of *semirufa* for unusually arid desert conditions is high. This species and *mimicus* may be regarded as the most xerophilous representatives of Myrmecocystus. The nests of *semirufa* are generally built in sand with a neat sand crater surrounding the entrance. The colonies are quite populous.

The insect which Cole described as *kennedyi* is a synonym of *semirufa*. I have also treated Emery's pale variety *testacea* as a synonym, since this color variant is clearly not a geographical race and grades to *semirufa* through intermediate forms. It is easy to confuse specimens

of *semirufa* with small, pale specimens of *mimicus*, for the hair pattern of the latter species often approaches the short, even, erect pilosity of *semirufa*. The thoracic structure of the two species is, however, quite different (see key) and this distinction holds regardless of the size of the worker. This gives a very satisfactory method for separating the two species.

15. Myrmecocystus yuma Wheeler

M. yuma Wheeler, Psyche, Vol. 19, p. 174 (1912) ♀.
Type loc: Yuma, Arizona. Types: A.M.N.H., M.C.Z.
Range: known from type material only.

According to Wheeler, this species makes small crater nests three or four inches in diameter in the open desert.

Genus Formica Linné

(Plate 56, figures 1–4)

The genus Formica possesses so many outstanding characteristics that one is apt to weary of the superlatives which are necessary to do them justice. Formica is, by a very substantial margin of species, the largest genus of ants in America north of Mexico. Its representatives constitute approximately one-sixth of our entire ant fauna. Since the genus is rare or absent over much of Mexico, it follows that the group contains an unusually large number of forms endemic to the United States and southern Canada. The genus has many qualities which make it especially favorable for myrmecological investigation. In Formica may be found a number of interesting habit patterns. These include slave-making, temporary social parasitism of various types, the formation of new colonies by a process akin to swarming and several distinct methods of nest construction. It may be doubted that any other genus furnishes better material for zoögeographical studies. Many of the species of Formica range widely and have produced numerous geographical races. There are also 'insular' species which occur in isolated mountains of the west. But to all these signal advantages must be added a distinction of a different sort. During the past quarter of a century the genus Formica has been burdened with an exceptionally vexing taxonomic problem which has caused much misunderstanding and confusion.

The writer must include himself with those myrmecologists who, since 1922, have followed Wheeler in rejecting Forel's subgenera Raptiformica and Serviformica without being fully aware of what this rejection involves. A more extensive acquaintance with this problem has convinced me that it cannot be as easily dismissed as has been supposed. There has been a general misunderstanding of one phase of this problem. Forel's two subgenera have always been considered together and have always been treated in the same way. Either they have both been accepted or both rejected. The question that one might be valid and the other unacceptable appears never to have been considered, yet it would seem that this is the truth of the matter. There is good reason for accepting Raptiformica as a valid subgenus; there is none for according Serviformica the same treatment. The explanation of this view, which has been followed in the present work, involves a rather lengthy consideration of early taxonomic developments within the genus. But since there seems to be no other way in which existing inconsistencies can be corrected, the following paragraphs have been devoted to the necessary explanation.

Although the problem actually began with the publication of a very ill-timed note by Forel in 1913, it is necessary to deal with previous views which Forel utilized as a basis for his observations. In 1908 Emery began the publication of his monograph of Palearctic ants and, in the section of that work which dealt with Formica, he proposed to break up the genus into a number of groups. Among these was the *sanguinea* group, based upon the presence of a clypeal notch and the *fusca* group, based upon a slender body, a narrow head and certain characteristics of the funicular joints. The *fusca* group as originally constituted by Emery contained not only *fusca* and *rufibarbis* but also *pallidefulva*, a fact whose significance will be presently shown Returning to the note which Forel published in 1913, it may be said that it proposed little more than the raising of the *sanguinea* and *fusca* groups to subgeneric status. No change was made in the species which Emery had assigned to the two groups nor were any new structural criteria brought forward for their better definition. But a novel twist resulted from Forel's attempt to augment previously recognized structural differences with habit pattern. The names which he selected for the two subgenera show more clearly than his text what he had in mind. The slave-making forms went into Raptiformica, the slaves into Serviformica. I do not believe that Forel ever intended to suggest that habit was to supplant structure as the definitive criterion for the recognition of the two subgenera. But by bringing habit into the matter and, more particularly, by his unfortunate choice of names, Forel had opened the way for such a charge. In the same year that

Forel's note appeared Wheeler's monograph on Formica was published. This extensive work brought into prominence a number of facts whose existence had not even been suspected by European specialists. This was especially true in the matter of habits. Wheeler's work was done without any knowledge of Forel's plan to link habits with structure but if he had deliberately set about to break down Forel's proposal Wheeler could not have shattered it more completely. He was able to demonstrate that there is a notable lack of uniformity in the habits of the New World species belonging to the *sanguinea* group. Many of them do not make slaves and others which do are willing to take slaves that clearly do not belong to the *fusca* group. I have no wish to minimize the importance of Wheeler's observations but it is necessary to appreciate exactly what he had shown in the case of Forel's subgenera. Wheeler had proven conclusively that the habits of Raptiformica are too variable to be of any service in taxonomy. He had shown that both of Forel's subgenera had been given names which are singularly inept. But no amount of contrary evidence derived from a study of habits could affect the status of either of Forel's subgenera for they were based on the structural features which Emery had used for the recognition of the *sanguinea* and *fusca* groups. Until these features can be shown to be unsuitable for subgeneric delimitation, the two subgenera can stand. In point of fact Wheeler took the first step toward the break-down of Serviformica in his treatment of the *fusca* group, but he never seems to have been aware of the significance of what he had done. Wheeler recognized the structural heterogeneity of Emery's original *fusca* group and proceeded to better the matter by removing from it *pallidefulva* and its allied forms. For these he set up the subgenus Neoformica. In so doing he took away from the *fusca* group the representatives whose structure best accords with the criteria on which that group was based. The *fusca* group, after Wheeler was through with it, contained no species which would give it any particular distinction. It graded without any structural break into the much larger *rufa* group. Thus Wheeler's recognition of the subgenus Neoformica destroyed the one basis which Forel might possibly have used to validate Serviformica. For Forel had been unwise enough to designate *fusca* as the subgenotype of Serviformica. With Neoformica established as a separate subgenus, there was nothing for it but to restrict Serviformica to those species which remained in the *fusca* group. And this was a dubious business at best for the revised *fusca* group is singularly deficient in characters which might be cited as subgeneric criteria.

It is curious that neither Wheeler nor Emery saw this matter in its proper perspective. Emery accepted both subgenera as valid and

presented several highly questionable structural criteria for the recognition of Serviformica. Wheeler, on the other hand, vigorously denied that either group ought to be recognized as a subgenus. In 1922 he published a brief but caustic note in which he stated that both subgenera were 'utterly untenable' and then failed to prove either of them so in the few remarks which followed.

There seems to be little hope of arriving at an acceptable solution of this problem unless we give up the practice of treating these subgenera as though they were Siamese twins and deal with each independently and according to its merits. It seems scarcely necessary to add that any such consideration must rest upon structure alone. There is nothing to be gained by further quibbling about habits. Let us look first at Raptiformica. Despite the possible implications of the note which Wheeler published in 1922, it may be asserted that Raptiformica does not intergrade with the other subgenera. It is unfortunate that the term 'notch' has been so generally applied to the clypeal incision present in the members of this group for this usually brings to mind a narrow indentation. The clypeal notch is not always narrow; at times it is a broad and shallow concavity which involves a considerable portion of the clypeal border. It should be further noted that in the species in which the size of the worker caste varies, the notch is, as a rule, more prominent in the larger workers than in the smaller ones. If, therefore, one is dealing with such a species and in this species the clypeal notch is weak, even in the largest workers, there will often be smaller individuals encountered in which the clypeus is virtually entire. As a rule, however, such small specimens retain a flattened portion at the center of the clypeal edge even when the notch is no longer present. This is true of the species *perpilosa*, which has a very weak clypeal notch and a worker caste in which the size varies considerably. It may be admitted that some of the smaller workers of this species are exceedingly difficult to handle if taken alone but this is no reason for citing them as proof that the subgenus Raptiformica intergrades with other groups. Unless I am very much mistaken, this was what Wheeler was attempting to say in his 1922 note, for one of the 'forms allied to *subpolita*' must have been *perpilosa*. But the factor to be stressed is not that the smaller workers of some of the species of Raptiformica lack a clypeal notch but that the larger workers and females of that group invariably have one. Moreover, this situation is met with in no other group of species within the genus Formica. I am ready to admit that with a better knowledge of the genus this distinction may be broken down, for the females of many of the species of Formica are at present unknown and it is quite possible that transitional species may be discovered. But I submit

that any unbiased appraisal of the present status of Raptiformica must lead to the conclusion that the group deserves subgeneric status.

The situation which marks Serviformica is wholly different. In an earlier paragraph I mentioned that the *fusca* group lacks subgeneric characters. It is necessary to substantiate this statement here. It is by no means a pleasant task to have to do so, for it is clear that for the past thirty-five years myrmecologists have been content to cite for the *fusca* group a set of supposedly definitive characters which cannot possibly be applied to a number of the species included in that group. Let us look for a moment at what these characteristics are. We are generally told that members of the *fusca* group are marked by a narrow head, a slender thorax and a petiole which is narrow and thick with a blunt border. As an afterthought, we are usually told that the color of the members of the *fusca* group differs from that of the *rufa* group. I shall have more to say about this last point presently.

If anyone wishes to prove to himself the complete futility of the above structural distinctions he need only secure a large worker of *F. subpolita* and examine its characteristics. The head of such a worker is fully as wide as it is long, the thorax is exceptionally short, broad and robust and the scale of the petiole is very wide with a sharp upper edge. By no stretch of the imagination could *subpolita* be fitted into the *fusca* group if one utilized the definitive characters just cited. I am ready to admit that I have picked an aggravated case to prove my point but the fact remains that a large number of the species in the *fusca* group fail to agree with the characteristics which are supposed to mark the group. What is worse, several of the characteristics commonly used to mark members of the *rufa* group will apply better to the *fusca* group than will its own diagnostics. There is only one circumstance which has prevented utter confusion between the members of the *rufa* and *fusca* groups. The two can in most cases be easily separated by their different color. For practical purposes this is the criterion which marks the *fusca* group. This characteristic is, however, a negative one. There is no distinctive '*fusca*' color! Instead, the color varies considerably, but it is only very rarely that it corresponds to the characteristic bicolored pattern that is so uniform in the *rufa* group. There is no reason why color should not be used to separate the members of the *fusca* group. If this is the easiest way to recognize these species, it is stupid to insist that other less obvious features be employed instead. But while color may be perfectly satisfactory as a practical method of separation, it is altogether unsatisfactory as a subgeneric criterion. It is on this point that much of the difficulty with the *fusca* group has arisen. If a group lacks the structural distinction that is expected of a subgenus, this cannot be supplied by

definition. This has been attempted with the *fusca* group and the result is not a happy one. Since the definitive structural criteria which have been cited for the *fusca* group will not apply to many of its members, there is surely no reason for using these same criteria as a basis for subgeneric status. One can agree with Wheeler that the subgenus Serviformica is 'utterly untenable' for at present, at least, it is founded more upon fiction than upon fact.

Before leaving the matter of the subgenera of Formica it is necessary to consider Coptoformica. In 1923 Müeller proposed this name for a subgenus which was to include the members of the *exsecta* group. Müeller had little new to offer as subgeneric characters for Coptoformica. But in revaluing the features which Emery had earlier used to distinguish the *exsecta* group, Müeller failed to realize that certain features shown by European representatives of the *exsecta* group will not apply to the American species. In several European forms the female is little larger than the largest worker and in *succica* it is definitely microgynous. The vestigial denticles on the basal border of the mandibles are particularly distinct in this form. It is true that the above characteristics will not apply to all the members of the *exsecta* group which occur in Europe but at the same time they give to the European species a distinction which is not duplicated in our forms. So far as is known, all the American species of the *exsecta* group have large females and the denticles on the basal border of the mandibles are usually lacking. As a result the main distinction for the group must rest upon the occipital excavation. Since this same feature is found in a less pronounced condition in some of the species in the *rufa* group, it is not hard to see why little attention has been paid to Coptoformica by myrmecologists on this side of the Atlantic. There would seem to be little reason to accept Coptoformica as a valid subgenus until better evidence has been advanced to support it.

I wish to comment on one couplet in the following key which is likely to cause difficulty. I refer to couplet 5 in which the *microgyna* group is brought out. It is difficult to express in a key the rather complicated situation which exists in this case. The *microgyna* female is, of course, invariably small and its size never exceeds that of the largest workers. The *rufa* and *fusca* females are usually large, and they are also usually much larger than the largest workers. If, as sometimes happens in the *rufa* group, the female is less than 8 mm. long, it will still be larger than the largest workers if the average size of the female is taken into consideration. But one may as well admit that in *dakotensis, fossaceps* and *reflexa* some of the smaller females are no larger than the largest workers. Moreover, the smallest females of *reflexa* are no larger than those of the *microgyna* group. Nevertheless I feel

that there is justification for the characters employed if it is made clear that the females of *dakotensis*, *fossaceps* and *reflexa* are much more smooth and shining than those of the *microgyna* group.

Key to the Subgenera and Groups of Formica

1. The second and third funicular segments taken together not more than one and one-fifth times as long as the first segment and often not that long.....Subgenus *Proformica*
   The second and third funicular segments taken together at least one and one-fourth times as long as the first segment and usually longer.....2
2. Anterior margin of the clypeus with a median, concave impression which may be narrow and notch-like or broad and shallow.....
   Subgenus *Raptiformica*
   Anterior border of the clypeus without a median concave impression, the margin evenly convex or angularly projecting in the middle or rarely with fine irregular serrations.....3
3. Antennal scape notably longer than the distance from the middle of the clypeal border to the middle of the occipital border; epinotum much rounded above with the angle between the basal and declivious faces very poorly marked.....Subgenus *Neoformica*
   Antennal scape not longer than the distance from the middle of the clypeal border to the middle of the occipital border or, if longer, the epinotum is distinctly angular and not excessively rounded above.....
   (Subgenus *Formica*).....4
4. Large workers with the occipital border very distinctly concave; the pronotum in profile not evenly convex but with a basal and declivious face which meet in an angle.....*exsecta* group
   Large workers with the occipital border at most very slightly concave, usually flat or slightly convex; pronotum in profile evenly convex, not angular.....5
5. Females feebly shining or subopaque, never more than 5.5 mm. in length and never larger than the largest workers, often smaller than the largest workers; erect hairs on the pronotum of the worker, when present, often clavate or spatulate.....*microgyna* group
   Females usually 8 mm. or more in length and notably larger than the largest workers, but if they are less than 8 mm. in length and no larger than the largest workers, they are very smooth and shining; erect hairs on the pronotum of the worker, when present, not notably clavate or spatulate.....6
6. Bicolored species, the head and thorax ferrugineous or yellowish red and notably lighter than the gaster or, if infuscated, the infuscation does not completely mask the ferrugineous ground color in the larger workers; frontal area usually shining, frontal lobes strongly divergent behind...*rufa* group
   Concolorous species or if bicolored the thorax is lighter than the head and gaster; frontal area usually opaque, frontal lobes at most moderately divergent behind, often parallel.....*fusca* group

Subgenus PROFORMICA Ruzsky

The three species which represent Proformica in North America form a group of exceptionally homogeneous structure. In this they differ from their Old World counterparts, which show considerably more structural latitude. This fact has, apparently, been responsible for one rather serious inaccuracy in the case of our species. Since *F.* (*Proformica*) *nasuta* has been designated as the subgenotype of the group, it is no more than natural that the characteristics of that species should have a special importance. The male of *nasuta* possesses extraordinary genitalia, the stipes of which project so far to the rear of the volsellae and the sagittae that the posterior third of the genitalia consists of the stipes only. This character has been extensively used as one of the subgeneric determinants for Proformica. It will, unfortunately, apply only in a very limited way to the North American species. In our species the tips of the stipes project beyond the other parts by an amount equal to approximately one-eighth of the over-all length of the genitalia. The situation is wholly different from what one finds in *nasuta* and it may be doubted that the stipe length in our species of Proformica is of much significance for there are several species in the subgenus Formica which possess equally long stipes.

The nesting habits of our three representatives of Proformica are, apparently, identical. Each species forms small colonies of a few hundred individuals with the nests usually constructed in soil beneath stones or other covering objects. Since these ants are extensively preyed upon by species in the *sanguinea* group, they are usually regarded as timid but they are by no means lacking in pugnacity and will usually defend the nest if it is disturbed. It would appear that their small size rather than their lack of pugnacity is what enables the *sanguinea* species to enslave them. Our species can be separated as follows:

Key to the species of Proformica

1. Extensor surfaces of the antennal scapes bearing a number of short, very delicate, erect, whitish hairs ..... *lasioides*
   Antennal scapes without erect hairs except for a small cluster at the extreme tip 2
2. Thorax with numerous erect hairs; surface of the body moderately shining ..... *neogagates*
   Thorax without erect hairs or with only one or two erect hairs; surface of the body strongly shining ..... *limata*

1. FORMICA (PROFORMICA) LASIOIDES Emery

F. subpolita var. *lasioides* Emery, Zool. Jahrb. Syst., Vol. 7, p. 664 (1893) ♀.
F. (*Proformica*) *lasioides* Emery, Zool. Jahrb. Suppl. 15, p. 100 nota (1912).

F. (*Proformica*) *neogagates* subsp. *lasioides* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 400, 539 (1913) ♀.

F. lasioides var. *picea* Emery, Zool. Jahrb. Syst., Vol. 8, p. 335 (1895) ♀.

F. fusca subpolita var. *picea* Wheeler, Boston Soc. Nat. Hist., Vol. 7, No. 7, p. 21 (1906).

F. lasioides var. *vetula* Wheeler, Psyche, Vol. 19, p. 90 (1912).

F. (*Proformica*) *neogagates lasioides* var. *vetula* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 540 (1913) ♀.

Type loc: Hill City, South Dakota. Types: M.C.Z.

Range: coast to coast in southern Canada and the northern United States. A southern extension occurs in the mountains of Oregon and California and another in the Rockies, where the insect occurs south to New Mexico. It is, however, rare or absent in the southern Appalachians.

The status of *lasioides* is very puzzling. Although Emery originally described it as a separate species, Wheeler always held it to be no more than a subspecies of *neogagates*. One must certainly agree with Wheeler that the only significant difference between *lasioides* and *neogagates* is the presence of small, erect hairs on the scapes of the former insect. This is most assuredly a very slight difference on which to base a species but, if *lasioides* is to be recognized at all, it will have to be as a species. It is out of the question to regard this form as a geographical race of *neogagates*. The ranges of the two are not absolutely identical but they occur coincidentally and without intergradation over an enormous area extending entirely across southern Canada and the northern United States. The very constancy of the scape difference under such circumstances may be taken as an indication that the hairs on the scape of *lasioides* are a better criterion of specificity than one would expect. But although I have restored *lasioides* to the specific status it originally possessed, I can see no reason for the continued existence of the variety *vetula*. This form differs in no way from *lasioides* except for its slightly darker color, a feature that has no geographical significance in this case. Since the overwhelming majority of the records for *lasioides* have to the present been attributed to *vetula*, it will, perhaps, not be particularly palatable to give up the use of the latter name. I believe, however, that this will have to be done for there is no sound method by which the two color phases can be separated.

2. Formica (Proformica) limata Wheeler

F. (*P*) *limata* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 541 (1913) ♀.

Type loc: Florissant, Colorado. Types: A.M.N.H., M.C.Z.
Range: southern Rockies and the mountains of eastern Utah. The insect apparently prefers to nest at elevations between 7–8000 feet.

It seems certain that Wheeler made an inadvertent error when he listed *limata* as a variety of *lasioides* in 1916. If we assume that it was his intention to reduce *limata* to varietal rank, it should have been assigned to *neogagates* rather than to *lasioides*, for *limata* lacks erect hairs on the antennal scapes. I do not believe that this was his intention for *limata* is marked by better structural distinctions than those which separate *neogagates* and *lasioides*. I cannot agree with Wheeler that the eyes of *limata* are larger than those of *neogagates*, but the strongly shining surface and almost hairless thorax of *limata* make it very easy to recognize.

3. Formica (Proformica) neogagates Emery

F. fusca subsp. *subpolita* var. *neogagates* Emery, Zool. Jahrb. Syst., Vol. 7, p. 661 (1893) ♀ ♀ ♂.
F. (*P*) *neogagates* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 536 (1913) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 618, pl. 22, fig. 83 (1947) ♀.
F. fusca var. *gagates* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 426 (1886) ♀ (part) (*nec* Latreille).
F. (*Proformica*) *neogagates* var. *morbida* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 538 (1913) ♀ ♀.
F. (*Proformica*) *neogagates* var. *vinculans* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 539 (1913) ♀ ♀.
Type loc: Beatty, Pennsylvania (by Wheeler's restriction, 1913). Types: M.C.Z.
Range: coast to coast in southern Canada and the northern United States. A considerable southern extension occurs in the Rocky Mountain region and the insect occurs sporadically in the mountains of Utah and Arizona as far south as the Huachucas. Unlike *lasioides* it is absent in Oregon and California but like that species it is rare or absent in the southern Appalachians.

I have treated Wheeler's varieties *morbida* and *vinculans* as synonyms of *neogagates*. There is little to be said for either of these color forms since each was described from a wholly inadequate series of workers and *vinculans* was characterized as ' transitional ' at the time of its description. Such color variants occur throughout the entire range of *neogagates* and have no geographical significance. It seems probable that the color differences in this species are due to the exposure of the nest site. At least I have always secured the paler

specimens in dry, sunny situations and this also seems to have been true of the collections made by Mr. Buren in Iowa. It must be admitted, however, that dark specimens often occur in nests which are equally sunny and dry. There is, therefore, little possibility of attaching any ecological distinction to the paler variants. They seem best regarded as nest varieties which are sometimes produced when the nest is fully exposed and unusually dry.

Subgenus RAPTIFORMICA Forel

The habits of the species of Raptiformica which make slaves have been repeatedly discussed and subjected to widely different interpretations. At one extreme stands the view expressed by Charles Darwin, that the slaves represent nothing more than an uneaten portion of food secured by raiding the nest of another species and that a slave-raid is little more than a specialized type of foraging. Wasmann, on the other hand, held that the raids are conducted for the express purpose of securing brood which can be reared and thus augment the population of the raiding colony. Wheeler in 1910 adopted an explanation between these extremes and authenticated his stand with much pertinent data. His admirable account has been used as the basis for the brief summary presented here.

The female of those species of Raptiformica which take slaves is unable to found her nest alone. As a result she is forced to secure aid during the nest founding period. This she does by forcing her way into a nest of some other species. In all probability the colony entered is an incipient one with only a few workers and a small amount of brood present for, although the intruding female will savagely attack the workers who resist her, it is unlikely that she could kill off all the workers of a flourishing colony. In a comparatively short time after she has entered the host colony, the intruding female has killed or driven away the workers and has appropriated their brood. Some of this brood she eats but most of it is tended solicitously. From this brood callow workers soon emerge and these accept the intruding queen as their own. It is by no means clear what becomes of the rightful queen but it is certain that she is disposed of in some fashion. It seems likely that she is killed by her own workers which have emerged from the brood after its appropriation by the intruding queen.

It may be seen that the essential elements needed for a slave-raid are present in the nest-founding reactions of the female. All that is necessary is that the impulse to enter a foreign nest should manifest itself simultaneously in most of the workers in the raiding colony.

There is good evidence to show that slave-raids always follow the nuptial flight and it is possible that they are prompted by the great excitement which this event produces in a colony. The raid begins with the formation of a loose column of raiders which approach and surround the nest to be raided. No attempt to enter the nest is made until a considerable number of raiders have arrived at the entrance. After a certain amount of preliminary investigation a large number of the raiders will force their way into the foreign nest. This is ordinarily followed by a frantic exodus of the rightful owners who carry away with them what brood they can. Thereafter the raiders pillage the remaining brood at their leisure and straggle back to their own nest loaded down with the pilfered brood. It seems certain that much of this brood is eaten, for the number of slaves in a colony is never as great as the amount of slave brood brought into it. It would seem, therefore, that a slave-raid represents an abortive attempt on the part of the workers to carry out the nest-founding reactions of the female. If this were followed exactly, the raiders would, of course, remain in the foreign nest. But, once they have appropriated the brood, their normal foraging instincts reassert themselves and they return to their own nest with the foreign brood which they undoubtedly treat as food. The above discussion will show why the slave-making species of Raptiformica confine their attention to a comparatively limited number of slave species. If Darwin had been correct and the only purpose of a slave-raid is to secure food, it is hard to see why the raiders would not enter the nest of any species which happened to be conveniently near and not too well defended. There are exceedingly few records of this sort although on rare occasions *sanguinea* has been observed raiding the nests of Myrmica and Lasius. But if the raiding worker is behaving in essentially the same manner as the nest-founding female, it follows that they would normally enter the nests of species which might be expected to aid in nest-founding. This and the ease with which the raided nest may be penetrated appear to determine the 'choice' of slaves. It may be added that there are many species of Formica whose habits would make them able to act as auxiliaries in nest-founding, which are not enslaved, apparently because they are able to keep the raiders out of their nests. The writer observed a striking instance of this sort in the La Sal Mountains of Utah. A raiding column of *F. puberula* was attempting to enter a large nest of *F. microgyna*. They failed to do so not because they were killed by the *microgyna* workers but because the latter industriously carried the raiders away from the nest as fast as they arrived.

If the following key is compared with that presented by Wheeler in 1913, it will be seen that specific rank has been given to many of

the forms which Wheeler treated as subspecies of *sanguinea.* Since the reason for these changes is the same in most cases, it will save considerable repetition to present a single discussion here. The majority of these subspecies were set up by Carlo Emery more than half a century ago. It was Emery's practice wherever possible to relate material coming from North America to European species. Since all of these insects were not strikingly dissimilar to the European *sanguinea,* Emery found nothing incongruous in treating them as subspecies of *sanguinea.* Emery undoubtedly regarded the *sanguinea* subspecies in exactly the same light as those which he assigned to *rufa* for in both cases Emery was basing his categories on structure and this was largely unavoidable since he had very little locality data in most cases. It is now apparent that neither of these assemblages can be treated as Emery suggested if the subspecies is to be regarded as a geographical race. In the case of *sanguinea* there is no possibility of assigning separate ranges to these variants. It is true that no two of them have exactly the same range but it is equally true that not one of them has a range to itself. In the eastern United States there are *rubicunda, subintegra, sublucida* and *subnuda* all coexisting in the New England region with the only distributional difference in their ranges arising from the fact that in some cases the range extends further south and west than in others. In the west there are *rubicunda, subnuda, puberula* and *obtusopilosa* (= *munda*) all occurring in the same stations over a large part of their respective ranges. While this affords great opportunity for intergradation, there is little evidence that intergrades are produced. There seems to be but one conclusion to be drawn from this fact; the forms involved are not geographical races but true species. At least I have treated them as such in the present work.

Key to the species of Raptiformica

1. Gaster clear reddish yellow, no darker than the head and thorax.....2
   Gaster brown to piceous black, usually darker in color than the head and thorax.....3
2. Antennal scapes of the largest workers surpassing the occipital margin by a little more than one third of their length; erect hairs abundant on the gula and on the entire dorsum of the insect.....*bradleyi*
   Antennal scapes of the largest workers surpassing the occipital margin by an amount about equal to the length of the first funicular segment; erect hairs sparse on the gula, mesonotum, epinotum and crest of the petiole, abundant only on the pronotum and the gaster.....*parcipappa*
3. Gaster strongly shining, with dilute pubescence which does not obscure the delicate shagreened sculpture.....4

Gaster opaque or feebly shining, the pubescence dense enough to partially obscure the finely coriaceous sculpture.....6

4. Basal face of the epinotum with many long, erect hairs; body hairs in general long and numerous.....*perpilosa*
Basal face of epinotum without erect hairs or with a cluster of short, erect hairs near the junction with the declivious face; body hairs in general not abundant and rather short.....5
5. Head and thorax reddish yellow; length of the largest worker 4.5 mm... *manni*
Head and thorax piceous brown; length of the largest worker 6 mm.... *oregonensis*
6. Dorsum of the thorax entirely devoid of erect hairs or with a few fine, short, inconspicuous erect hairs on the pronotum only.....7
Dorsum of the pronotum and the mesonotum with conspicuous erect hairs, erect hairs usually present on the epinotum also.....10
7. Head of the largest workers narrow, when seen in full face there is no space between the margin of the eye and the margin of the head; head and thorax sordid yellowish red or brown.....8
Head of the largest workers broad, when seen in full face there is a distinct space between the margin of the eye and the margin of the head; head and thorax ferrugineous.....9
8. Antennal scapes slender, not notably thickened at the tip; basal face of the epinotum without a transverse impression.....*pergandei*
Antennal scapes robust, their tips distinctly thickened; basal face of the epinotum with a slight but distinct transverse impression.....*emeryi*
9. The declivious face of the epinotum descending at a right angle to the plane of the basal face; scale of the petiole with a blunt crest; gaster clear brown.....*subintegra*
The declivious face of the epinotum slightly inclined forward, its angle with the basal face greater than a right angle; scale of the petiole usually with a sharp crest; gaster piceous brown.....*sanguinea* subsp. *subnuda*
10. Gaster evenly covered with long, stout, silvery, erect hairs which are blunt at the tip; hairs on other parts of the body only a little less abundant than those of the gaster.....11
Erect gastric hairs yellow in color and not notably blunt at the tip; hairs on other parts of the body much shorter and sparser than those of the gaster.....12
11. Head and thorax clear, ferrugineous red, the head not infuscated behind *obtusopilosa*
Head and thorax deep red, the head distinctly infuscated behind..... *obtusopilosa* subsp. *alticola*
12. Head seen in full face with the eyes strongly projecting beyond the lateral margins; clypeal notch feeble; female concolorous, uniform yellowish red *curiosa*
Head seen in full face with the eyes very slightly projecting beyond the lateral margins or not projecting beyond the lateral margins at all; clypeal notch prominent; females bicolored.....13
13. Pubescence on the antennal scapes abundant and prominent, not com-

pletely appressed over much of the scape, particularly on the inner surface near the tip where it is distinctly erect.....*puberula*
Pubescence on the antennal scapes very short, fine and completely appressed.....14

14. Head of the largest workers with the occipital angles much rounded, the sides strongly converging toward the insertion of the mandibles; thorax moderately shining.....*sublucida*
Head of the largest workers trapezoidal, the occipital angles moderately rounded, the greater part of the occiput flat, sides of the head gradually converging toward the insertion of the mandibles; thorax feebly shining or opaque.....15

15. Scale of the petiole with a sharp crest, the median notch in the crest usually well-developed; head usually not infuscated.....*rubicunda*
Scale of the petiole with a blunt crest, the median notch in the crest usually feeble or absent; head in most specimens wholly or partially infuscated.....*wheeleri*

4. Formica (Raptiformica) bradleyi Wheeler

F. bradleyi Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 423 (1913) ♀ ♂.
Type loc: Georgetown, Colorado. Types: A.M.N.H., M.C.Z.
Range: Colorado to Alberta and North Dakota.
Slave: None known.

E. W. and G. C. Wheeler have shown (1944) that *bradleyi* is an arenicolous species. The insect nests among sand dunes or in other sandy areas where the vegetation is sparse. The nests consist of a low crater of excavated soil about six or seven inches in diameter with multiple openings. Some of the nests which the Wheelers studied were built at the base of grass clumps whose roots gave a stability to the loose soil in which the nest passages were constructed.

5. Formica (Raptiformica) curiosa Creighton

F. curiosa Creighton, Amer. Mus. Novitates, No. 773, p. 5, fig. 2 (1935) ♀ ♀.
Type loc: Lake McGregor, Montana. Types: A.M.N.H.
Paratypes: M.C.Z., Coll. W. S. Creighton, Coll. A. C. Cole.
Range: known only from type material.
Slave: *F. lasioides.*

6. Formica (Raptiformica) emeryi Wheeler

F. pergandei Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 268 (1905) ♀ ♀ (*nec* Emery).
F. emeryi Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 419 (1913) ♀ ♀.

Type loc: Broadmoor, Colorado Springs, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.
Slave: *F. neogagates.*

7. Formica (Raptiformica) manni Wheeler

F. manni Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 420 (1913) ♀ ♀.
Type loc: Kiona, Washington. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: Washington, Oregon, Idaho and northern California.
Slave: None known.

F. manni appears to be another species with strongly arenicolous tendencies. It nests in the gravelly or sandy soil of desert areas and the nests, which are small, are often built under stones.

8. Formica (Raptiformica) oregonensis Cole

F. oregonensis Cole, Amer. Mid. Naturalist, Vol. 20, No. 2, p. 368 (1938) ♀.
Type loc: Pendelton, Oregon. Holotype: Coll. A. C. Cole. Paratypes: Coll. A. C. Cole, U.S.N.M., M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.
Slaves: None known.

9. Formica (Raptiformica) obtusopilosa Emery

F. sanguinea subsp. *obtusopilosa* Emery, Zool. Jahrb. Syst., Vol. 7, p. 648 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 414 (1913) ♀.
F. pergandei var. Emery, Zool. Jahrb. Syst., Vol. 7, p. 647 (1893) ♀.
F. munda Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 267 (1905) ♀ ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 416 (1913) ♀ ♀.
Type loc: New Mexico. Types: none in this country.
Range: Rocky Mountain Region from New Mexico to Alberta. Also occurs in the Black Hills of South Dakota.
Slaves: None known. It is thought that this species does not make slaves.

F. obtusopilosa appears to be primarily an ant of the lower foot-hills of the Rockies. In central Colorado its nests occur at elevations of about 6000–7000′. The colonies are comparatively small, consisting of only a few hundred individuals and the nests are obscure. They are usually constructed in open, sunny meadows.

It is unfortunate that Wheeler was misled by Emery as to the nature of the insect which he described as *munda*. Wheeler had sent specimens of this ant to Emery who examined them and gave the opinion that they were the same as an unnamed variety of *pergandei* which Emery had mentioned in 1893. On the basis of this assertion, Wheeler naturally concluded that the specimens which he had sent Emery could not be the same as the latter's *obtusopilosa*. He therefore described them as *munda*. Later Emery altered his position in the matter and held that Wheeler's *munda* and the unnamed 'variety of *pergandei*' were the same as his *obtusopilosa*. Since *munda* was described from a wealth of material and with an extensive first-hand knowledge of the habits of the insect, it is unfortunate that this name must become a synonym of *obtusopilosa*. For Emery described *obtusopilosa* from a single worker and it is clear, since he did not recognize the relationship of this worker to those of his unnamed 'variety of *pergandei*', that Emery had a very imperfect concept of the characteristics of *obtusopilosa* when he described it. Such considerations will not, however, allow the name *munda* to stand.

10. Formica (Raptiformica) obtusopilosa alticola Wheeler

F. munda var. *alticola* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, No. 8, p. 534 (1917) ♀.

Type loc: Jefferson County, Colorado (elevation 9500′). Types: A.M.N.H., M.C.Z.

Range: known only from type material.

Slaves: None known.

I have retained *alticola* as a subspecies largely because it seems impossible at present to determine the exact status of this variant. The differences which separate *alticola* from *obtusopilosa* are trivial and consist only of its darker infuscation and slightly more abundant cephalic pilosity. The first characteristic is notoriously unreliable and there would be little reason for according *alticola* subspecific status were it not for a distributional peculiarity which is supposed to mark it. The typical *obtusopilosa* is not known to nest at elevations above 7000′ even in the southern portions of its range. The type series of *alticola* was taken by Oslar at an elevation said to be 9500 feet. A number of Oslar's elevational records are obviously inflated, as for example his records of colonies taken on several peaks in Colorado at elevations of 14,000 feet, a scarcely credible situation even for the southern Rockies. But Oslar might have taken the types of *alticola* at an elevation of 9500 feet and, if this record is reliable, it indicates

that *alticola* has a range which is separated by elevation from that of the typical *obtusopilosa*. Until *alticola* is better known it seems best to retain it as a subspecies of *obtusopilosa*.

11. Formica (Raptiformica) parcipappa Cole

F. parcipappa Cole, Ann. Ent. Soc. Amer., Vol. 39, No. 4, p. 616 (1946) ♀.
Type loc: Nampa, Idaho. Types: Coll. A. C. Cole. Paratypes: Coll. W. S. Creighton.
Range: known from type material only.
Slave: None known.

12. Formica (Raptiformica) pergandei Emery

F. pergandei Emery, Zool. Jahrb. Syst., Vol. 7, p. 646, pl. 22, fig. 1 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 418(1913) ♀.
Type loc: District of Columbia. Types: A.M.N.H., M.C.Z.
Range: apparently confined to the northeastern United States.
Slave: *F. pallidefulva* ?

Emery was of the opinion that *pergandei* is a slave-maker and this may be true. But no raid of this rare species has ever been reported. The type colony, in which *pallidefulva* was present, may have been a young nest in which the host workers still remained in the colony. We need more data on the habits of this little-known species.

13. Formica (Raptiformica) perpilosa Wheeler

F. fusca subsp. *subpolita* var. *perpilosa* Wheeler, Mem. Revist. Soc. Sci. Ant. Alzate, Vol. 17, p. 141 (1902) ♀.
F. perpilosa Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 421 (1913) ♀ ♀ ♂.
Type loc: Canyon City, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: western Texas to Arizona and southern Nevada. The types appear to have come from the northern limit of the range. The insect also occurs in northern Mexico.
Slaves: None known. It is thought that this species does not make slaves.

Although I have made considerable effort to do so, I have never been able to discover a nest of *perpilosa*. According to Wheeler the colonies are populous but the nests themselves are often rather obscure. They consist of low mounds constructed around the roots of bushes and trees which grow along stream bottoms in the western deserts.

14. Formica (Raptiformica) puberula Emery

F. sanguinea subsp. *puberula* Emery, Zool. Jahrb. Syst., Vol. 7, p. 648 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 413 (1913) ♀ ♀ ♂.

Type loc: Hill City, South Dakota. Types: A.M.N.H.

Range: Rocky Mountain Region from New Mexico north to Montana. Also occurs in the Black Hills of South Dakota, the mountains of Utah and sporadically in western Texas and Washington.

Slaves: *F. fusca, F. neoclara, F. montana, F. lasioides, F. pallidefulva* subsp. *nitidiventris.*

Since some doubt has been cast on the value of the character that Emery used to distinguish *puberula* by Wheeler's statement that the insect does not have erect pubescence on the antennal scapes, it seems advisable to attempt a clarification of this point. The difficulty apparently arose from the fact that Wheeler expected all the pubescence on the scapes to be erect, which is certainly not the case. There is, however, an area on the inner surface of the scape where the pubescence is distinctly erect, but this can only be seen if the scape is viewed from the proper angle. It seems fairly certain that Wheeler's failure to recognize the above distinction led him into a number of errors in connection with this species. The material identified as *puberula* by Wheeler is by no means uniform. When I examined it in 1939 it contained a number of specimens belonging to *wheeleri* as well as other doubtful inclusions. I believe that Wheeler was in error in recording *puberula* from Missouri and Illinois. The specimens so treated I regard as *subintegra.* The altitudinal range of *puberula* also seems to be greater than Wheeler supposed. Although it may be agreed that many of the records come from comparatively low elevations, the insect frequently occurs in the same stations as *subnuda* at elevations up to 8000 feet. The nests of *puberula* are usually fully exposed and often constructed in very stony soil. It does not seem particularly prone to use thatching above the nest, although there may be loose soil thrown out around the entrance.

15. Formica (Raptiformica) rubicunda Emery

F. sanguinea subsp. *rubicunda* Emery, Zool. Jahrb. Syst., Vol. 7, p. 647, pl. 22, fig. 2 (1893) ♀ ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 406 (1913) ♀ ♀ ♂.

Type loc: Pennsylvania (by Wheeler's restriction, 1913). Types: none in this country.

Range: southern Ontario and New England west to Colorado and south through the Appalachians to North Carolina.

Slaves: *F. fusca, F. montana, F. neogagates, F. schaufussi, F. pallidefulva* subsp. *nitidiventris.*

The nests of *rubicunda* are usually situated in open woodland areas and are built under a variety of covering objects of which large, partially rotten logs appear to be a favorite. Considerable use is made of thatching. The colonies are often populous.

16. Formica (Raptiformica) sanguinea subnuda Emery

F. sanguinea subsp. *rubicunda* var. *subnuda* Emery, Zool. Jahrb. Syst., Vol. 8, p. 335 (1895) ♀.

F. sanguinea subsp. *subnuda* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 409 (1913) ♀ ♀ ♂.

F. sanguinea subsp. *aserva* Forel, Ann. Soc. Ent. Belg., Vol. 45, p. 395 (1901) ♀ ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 404 (1913) ♀ ♀ ♂.

Type loc: Yale, British Columbia. Types: M.C.Z.

Range: coast to coast in Canada as far north as Newfoundland, the Yukon and central Alaska. There is a limited southern extension in the New England states and a very considerable one in the Rocky Mountain region where the insect occurs as far south as New Mexico. Also occurs in many of the mountains of Utah and Arizona.

Slaves: *F. fusca, F. neorufibarbis* subsp. *gelida.*

Cole (1940) has reported this insect (*aserva*) from the Great Smoky Mountains National Park, Tennessee, but this record almost certainly applies to dark specimens of *rubicunda.* Even in the latitude of southern New England *subnuda* is limited to areas of considerable elevation and there is a complete lack of records from that part of the Appalachians which lies south of New York. This is only one of a number of confusing points which have surrounded the variant *aserva.* The types of this variant were taken by Forel at Toronto, Ontario, and he observed that the several colonies which he examined contained no slaves. As a result he postulated that *aserva* never takes slaves. This belief was rigorously adhered to as one of the distinctive peculiarities of *aserva* until 1946, in which year Gregg published data showing that *aserva* does take slaves. In the meantime Wheeler had shown that *subnuda,* which differs from *aserva* only in the absence of infuscation on the head and thorax, frequently lacks slaves in old colonies. It is interesting to note that Wheeler anticipated Gregg's observation but, because he adhered strictly to Forel's dictum, Wheeler

failed to appreciate the significance of what he had discovered. Wheeler had certain specimens coming from British Columbia which had slaves in the nest but whose color was dark, like that of *aserva*. He treated these as 'very dark' specimens of *subnuda* for, since slaves were present, he would not believe that they were *aserva*. It now is clear that the only feature that separates the two insects is a slight and fluctuating difference in the color of the head and thorax. There is no way in which this color can be correlated with distribution to permit the recognition of *aserva* as a geographical race. Except for the southern extension in the Rockies, where the dark phase apparently does not occur, *subnuda* and *aserva* occur together from coast to coast across southern Canada. Since there can be no question of separate specificity in this case, and since the two are obviously not geographical races, it must be recognized that *aserva* is nothing but a minor color phase of *subnuda* which should never have been named.

Finally I wish to present the reasons why *subnuda* has been retained as a subspecies of *sanguinea*. In both structure and habits (see below) *subnuda* is more closely related to the European *sanguinea* than any other North American form. To this may be added the remarkable distribution of *subnuda*, which extends well into northwestern Canada and Alaska. Since *sanguinea* has produced at least one race in eastern Siberia, the spatial separation between this Asiatic race and *subnuda* is not excessive, although the two do not now have adjacent ranges.

The nesting habits of *subnuda* are extraordinarily flexible, as would be expected of an insect which occurs over such an enormous range. The nests may be constructed in heavy woods (either deciduous or coniferous), in open woods or in fully exposed areas. They may be built in open soil, in and under rotten stumps and logs or beneath stones. The nests are often banked with thatching, but this is not invariably the case. *F. sanguinea subnuda* is an aggressive and active ant and often changes its nest.

17. Formica (Raptiformica) subintegra Emery

F. sanguinea subsp. *rubicunda* var. *subintegra* Emery, Zool. Jahrb. Syst., Vol. 7, p. 648 (1893) ♀ ♀.

F. sanguinea subsp. *subintegra* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 267 (1908); Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 410 (1913) ♀ ♀ ♂.

F. sanguinea subsp. *subintegra* var. *gilvescens* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 412 (1913) ♀.

Type loc: District of Columbia. Types: A.M.N.H., M.C.Z.

Range: eastern Canada and New England south through the Appalachians to North Carolina and west to Wisconsin.
Slaves: *F. fusca, F. montana, F. neogagates, F. schaufussi, F. pallidefulva* subsp. *nitidiventris.*

The nests of *subintegra* are constructed in rather open woods or sunny meadows. Buren (1944) reports that this species is common in lawns at Ames, Iowa, and Cole (1940) has published an interesting observation on two nests which he discovered in the Great Smoky Mountain National Park. These nests, which were apparently temporary ones, were constructed in cavities in litter lying on the surface of the soil and covered by leaves. Both nests were large and contained much brood and many slaves.

I have had no hesitation in treating Wheeler's variety *gilvescens* as a synonym of *subintegra.* It would seem that from the start, this variety has depended upon characteristics drawn from immature individuals or incipient colonies or both. The color distinction attempted by Wheeler was obviously fallacious, for he admitted that the individuals which showed this pale coloration most clearly were immature. The pilosity of *gilvescens* is not, in my opinion, significantly different from that of *subintegra.* There remains the matter of the very feeble clypeal notch, but this again is what one might expect from the smaller individuals of *subintegra* and it may be noted that the largest individuals in the type series of *gilvescens* were only 5 mm. in length. In 1940 the Wessons published observations to show that the raids of *gilvescens* are less highly organized than those of *subintegra.* Here again, it seems to me that the conclusion has been based on the action of a young colony, for the Wessons estimated that the number of *gilvescens* raiders which they observed was at most three hundred and, if this was the major part of the colony, it was certainly a small one and its raids might have been expected to show less precision than those of a fully developed nest. Until more conclusive evidence as to the separate nature of *gilvescens* can be brought forward I prefer to regard it as a synonym of *subintegra.*

18. Formica (Raptiformica) sublucida Wheeler

F. sanguinea subsp. *rubicunda* var. *sublucida* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 408 (1913) ♀.
Type loc: Stony Brook Reservation, Boston, Massachusetts. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: New England west to the Black Hills of South Dakota.
Slave: *F. fusca.*

Although Wheeler described *sublucida* as a variety he was of the opinion that it was, perhaps, a subspecies. I believe that it should be regarded as a separate species for in many respects the cephalic structure of the largest workers is unique. The occipital angles are strongly rounded and the sides of the head slope sharply inward from the level of the eyes to the insertion of the mandibles. As Wheeler noted, the frontal area is very shining and so are the cheeks but I cannot see that the rest of the insect is much more shining than *rubicunda*. Since this was the principal distinction that Wheeler used to separate the two in his 1913 key, it seems very likely that a number of records published for *rubicunda* may actually be those of *sublucida*. The range of *sublucida* extends at least as far west as South Dakota for the writer took a fine colony in the Black Hills in the summer of 1933.

19. Formica (Raptiformica) wheeleri Creighton

F. wheeleri Creighton, Amer. Mus. Nat. Hist. Novitates, No. 773, p. 1, fig. 1 (1935) ♀ ♀.

Type loc: Warner Ranger Station, La Sal Mountains, Utah. Types: A.M.N.H. Paratypes: M.C.Z., Coll. W. S. Creighton, Coll. A. C. Cole.

Range: mountains of eastern Utah, western Colorado and northern New Mexico and Arizona.

Slave: *F. lasioides*.

Since I have encountered this insect only twice in the field, it may be unwise to attempt to generalize about its nesting habits. On both occasions the nests were situated in open aspen groves and were constructed under stones which were not banked with detritus.

Subgenus Formica Linné

Species belonging to the *rufa* group

The only species in the *rufa* group which presents any serious taxonomic difficulty is *F. rufa* itself. The treatment accorded *F. rufa* in this volume is at wide variance with the plan I advocated in 1940. It has been necessary to separate the complex of forms previously considered as belonging to *rufa* into six species. Since the same general considerations apply in each case, it seems advisable to present a single account of these changes here. Much repetition is avoided if this is done.

The accumulation of infraspecific variants within *F. rufa* is a matter of long standing. As the taxonomy of this species has steadily grown more intricate, there have been various plans suggested to simplify the situation. Most of these plans have proposed to break down *rufa*

into two or more species and most of them have been rejected by the majority of myrmecologists. Since I shared this view in 1940 I have been interested in trying to discover why such revisionary proposals have hitherto been unacceptable. In my opinion they have been rejected because too much stress has been placed on ecological differences and not enough on structure. It has been assumed that no structural differences of any consequence exist in the complex of forms which have been assigned to *rufa*. Since most of these subspecies and varieties were originally recognized on the basis of minor differences of pilosity and color, the attempt has been made to augment these same minor differences with distinctions based on habit. It can be shown that groupings secured in this way are usually without specific significance. For this reason in 1940 I rejected Wheeler's earlier attempt to split *rufa* into two species. An extensive field acquaintance with most of the North American variants assigned to *rufa* had convinced me that his plan to segregate the mound-building forms into one species (*rufa*) and the stump or log-dwelling forms into another (*truncicola*) was entirely unsatisfactory. Not only is there no clear borderline between the habits of the two groups but the habit patterns do not fall into line with minor structural details, as Wheeler supposed.

While I still believe that Wheeler's plan for the division of the *rufa* complex is unsound, I am bound to admit that the arrangement which I proposed in 1940 is equally unsatisfactory. At that time I suggested that all the variants of *rufa* be treated as subspecies. This treatment eliminated the discrepancies of habit which were impossible to handle under Wheeler's plan. Since nothing more than subspecific status was involved, the customary minor differences which marked the variants could be used as separatory characters and if these differences showed a tendency to intergrade, it did not affect the status of the variants involved. The weakness of this arrangement lay in the coincidental ranges of several of the subspecies. In 1940 my views on the distributional characteristics of a subspecies were not what they are now. Because of this change in view I now find the arrangement which I proposed in 1940 in large part unacceptable. It is impossible to believe that *obscuripes*, whose range partially or entirely blankets those of fourteen of the eighteen forms involved, can be considered as belonging in the same species as the forms with which it coexists. This fact, and others like it, call for a revaluation of the status of many of the *rufa* variants. But these zoögeographical discrepancies were only one of the reasons which prompted me to attempt a further revision of the *rufa* complex. As more material was examined, it became apparent that some of the forms are inherently variable in the matter of hair pattern. In 1940 I attributed this variation to intergradation between subspecies but I now believe that there are cases

in which this explanation will not apply. But if a variant has no particular constancy in hair pattern, as seems to be the case with *integroides* and *ravida*, it is clear that they cannot be identified in a key based largely on the hair pattern. Perhaps it is more accurate to say that they can be identified as any one of half a dozen forms in such a key. At any rate, it seemed necessary to look for something which could be used in those cases where hair pattern is not suitable as a means for separation. As a result I reexamined much of the material on which my 1940 paper was based and was surprised to find that, once hair pattern is relegated to a position of secondary importance, it is not difficult to discover very sound characters which have, so to speak, been obscured by pilosity. In certain cases the differences are more clearly marked in the female than in the worker but I believe that in every case they are distinct enough and constant enough to permit them to be used as the basis for specific status. Furthermore, if the *rufa* complex is divided into species on this basis, most of the distributional inconsistencies embodied in my 1940 arrangement are eliminated.

So treated the *rufa* complex breaks into the following species:

F. obscuripes Forel
= var. *melanotica* Emery
subsp. *ravida* Wheeler

It is obvious that hair pattern is of little significance here for *obscuripes* is extremely hairy and *ravida*, in its 'typical' condition, nearly hairless. The two forms have in common a cephalic structure in which the length of the head of the major is no greater than the width. In very large workers the head is often a little wider than long. In addition, the gula and genae are moderately shining. The major part of the gula is covered with a delicate shagreening and there are also small, scattered but distinct punctures present. In the female the genae and the gula are even more shining than in the worker and in the female there are coarse scattered punctures on the pronotum, scutum, mesosternum and mesoepisternum. Between these punctures the surface is finely shagreened or minutely coriaceous and granulose. Similar coarse punctures sometimes occur on the mesosternum.

F. integroides Emery
= var. *subcaviceps* Wheeler
subsp. *coloradensis* Wheeler
subsp. *planipilis* Creighton
subsp. *propinqua* Wheeler
subsp. *subfasciata* Wheeler
subsp. *subnitens* Creighton

In this group the head of the major is a little longer than broad and the gula and cheeks (except in *subnitens*) are very feebly shining or dull. The gula shows an even, coriaceous surface in which the sculpture is sufficiently heavy to mask any piligerous punctures which may be present. The female, where known, is much like that of *obscuripes* but usually somewhat larger and with the head less shining. It may be doubted that *subnitens* really belongs in this group for, although it resembles *integroides* in the shape of the head, its cephalic sculpture is very different from that of the other forms.

F. integra Nylander
subsp. *haemorrhoidalis* Emery
subsp. *tahoensis* Wheeler

The significant feature which marks this group of forms is found in the female rather than in the worker. In the female there is a total lack of coarse punctures on the pronotum, scutum, mesosternum and mesoepisternum. The pronotum and the scutum are covered with an even, fine and very dense, granulo-reticulate sculpture. On the mesosternum and mesoepisternum the surface is uniformly covered with minute, close-set punctures. This gives to the last two areas a somewhat more shining appearance than is found in *obscuripes* and *integroides* but this superficial difference is far less striking than the actual sculptural difference which produces it. As far as the worker of this group is concerned, I confess that I have been unable to discover anything but the lack of erect hairs which will mark this caste. It may be said, however, that the group is remarkably constant in this particular. The thoracic dorsum is either completely devoid of erect hairs or there are at most one or two inconspicuous, short hairs at the rear of the mesonotum. The erect pilosity on other parts of the body is somewhat less constant for there may or may not be one or two hairs on the gula and the crest of the petiole. But I have never seen any tendency on the part of these forms to vary beyond the limits noted and for this reason their hair pattern becomes a matter of more significance than is true with the more variable representatives.

F. obscuriventris Mayr
= var. *gymnomma* Wheeler
subsp. *clivia* Creighton

This group is marked by a very distinct clypeal structure which is the same in worker and female. The median lobe of the clypeus has a steep face at either side which descends abruptly to a rather deep and pit-like clypeal fossa. The anterior edge of the clypeus slopes

rearward into the clypeal fossa and rises through an abrupt curve to the median lobe. The median lobe usually shows prominent striae interspersed with punctures and is rather shining. In all other groups except *lacviceps* the median lobe of the clypeus slopes gradually to the antennal fossae, the latter are not pit-like and the anterior edge of the clypeus joins the median lobe through a broad and gradually sloped surface and not through an abrupt curve at the front.

F. lacviceps Creighton

The shape of the clypeus in *lacviceps* is similar to that of *obscuriventris* but the side faces of the median lobe are less abrupt and the clypeal fossae are not as deep. The clypeus of the worker is striate and punctate and moderately shining but the gula and genae are very strongly shining, with small scattered punctures present but scarcely any shagreening between them. The female of *lacviceps* has an ecarinate clypeus which has no sculpture except small scattered punctures. The head and gaster of the female are strongly shining with small scattered punctures. The thorax is less shining than the head and gaster but more shining than that of any of the other species.

F. mucescens Wheeler

The peculiar gastric pilosity of the worker of *mucescens* allies it to *ciliata* and *comata* but the female is unique. In view of the large number of erect hairs in the worker, it is astonishing to find the female almost hairless. The female has a dull surface which is finely and densely coriaceous or granulose. This surface is covered with rather abundant pubescence which is appressed over most of the body but semi-erect at the base of the gaster and more fully erect on the occiput, genae and scutellum. As far as the female is concerned, there is no other species in the *rufa* group which closely resembles *mucescens*.

Before leaving this subject it seems well to note that some of the species just enumerated are marked by a characteristic type of nest habits and others are not. Thus *obscuripes* and its subspecies *ravida* are both mound-builders which prefer fully open nest sites. Among the subspecies of *integroides* on the other hand, at least four different types of nests are found. I have mentioned this in the hope that investigators will appreciate the difficulties involved in attempting to correlate habits with structure.

From what has gone before it should be apparent that the nesting habits of the members of the *rufa* group have been extensively studied. In many cases these studies have been intended to emphasize differences between the species. It is all the more remarkable, therefore,

that they agree so well in one respect. While the final form of the nest shows considerable variation it is almost always true that thatching plays a large part in its construction. The only possible exceptions to this general rule would seem to be *prociliata* and *subnitens*, which use little or no thatching in their nests. In the other species the amount of thatching used varies considerably and this, coupled with the type of nest site chosen, has a notable effect on the final form of the nest. When the nest is started under a stump or log, unless the thatching is used with great freedom, it will not entirely cover the object. Instead, it will accumulate as a drift or bank about its base. But if the nest is started under some low or small object, the thatching may completely engulf it. In this event a dome or mound type of nest results. The best known mound maker of this group is, of course, *obscuripes*, whose nests often form a conspicuous feature of the landscape in the west. Cole (1932) has shown that the nests of *obscuripes* are usually built at the base of a living sage-brush plant. As the mound grows the ants kill the plant by stripping off the bark and squirting formic acid against the cambium layer. The dead plant is subsequently removed, bit by bit from the mound. Another interesting observation on the habits of *obscuripes* was published by Weber in 1935. He showed that this species has no true marriage flight. Instead of the usual mass egress of sexual forms, the males and females of *obscuripes* emerge from the nest singly or in small groups. This process continues for the better part of a month. The significance of this interesting phenomenon is by no means clear. As Dr. W. M. Wheeler pointed out, it parallels a condition described for certain species of Cataglyphis which Kuznetzov-Ugamsky observed in the deserts of middle Asia. But *obscuripes* can certainly not be considered a desert-dweller. Moreover there is no suppression of the marriage flight in many highly xerophilous species belonging to such genera as Pogonomyrmex, Pheidole, etc. It seems doubtful that this peculiar habit is directly correlated with the environment, although one can agree with Dr. Weber that it must present a very considerable hazard to fertilization. Perhaps this is why there have been no published reports of the nest-founding activities of *obscuripes*. As I shall show in the following paragraphs, we are badly in need of information on this point, not only for *obscuripes* but for most of the members of the *rufa* group as well.

As early as 1910 W. M. Wheeler expressed the opinion that most, if not all, of the species in the *rufa* group were probably temporary social parasites. Wheeler's belief was based on the fact that several European representatives of the *rufa* group had been taken from young colonies where a host ant (usually *F. fusca*) was present. Wheeler argued that if the European species behave in this fashion,

the North American species might be expected to show similar habits. In addition Wheeler cited the unusual females of such species as *oreas* and *ciliata*, whose comparatively small size and extravagant pilosity might indicate a parasitic behavior in the nest-founding process. Wheeler had demonstrated, by experiments in artificial nests, that queenless colonies of *fusca* can be made to accept females of *integra* and *obscuriventris*. But I believe that it is correct to state that he had never found natural mixed colonies of these two species. The only positive evidence which Wheeler had in the case of the American species was that furnished by *dakotensis*. In 1902 Muckerman discovered young mixed colonies containing females of *dakotensis* and workers of *dakotensis* and *fusca*. But the female of *dakotensis* is marked by several features which would indicate that it has a parasitic type of nest-founding. The *dakotensis* queen is a comparatively small insect, only a little larger than the largest worker and its surface is very smooth and shining. It is quite unlike the large females possessed by many species in the *rufa* group and it is not at all surprising that *dakotensis* should have proven to be a temporary social parasite. But it is surprising that with no other evidence than this Wheeler should, in his 1913 monograph of Formica, have cited 'probable' hosts for many of the species in the *rufa* group. What is more surprising still is that these conjectural hosts have been accepted with nothing more than Wheeler's guess as the basis for their acceptance. It is somewhat ironical that the only additional evidence in support of Wheeler's theory has come from a species which was unknown to him in 1913. An incipient colony consisting of a female of *prociliata* and workers of *nitidiventris* was reported by Buren in 1944. Not only have Wheeler's hypothetical hosts failed to materialize but no others have been found to replace them.

In the thirty-eight years that have elapsed since Wheeler first presented his postulate, the number of published field records for our members of the *rufa* group has increased to a very substantial figure. There is little point in citing the total for, even if one had the patience to round up all the records, the figure itself would have limited significance. Many of the records are based upon cabinet specimens which were sent, without accompanying field data, to specialists for identification. But a much more significant showing can be secured from those records which have resulted from the first-hand field observations of the specialists themselves. For example, *F. obscuripes* has been observed in the field at more than one hundred and fifty stations by W. M. Wheeler, G. C. Wheeler, A. C. Cole, Neal Weber and myself. Since *obscuripes* usually produces an abundance of colonies in areas where it is well established, it is safe to say that the

total number of colonies examined has been far larger than the total list of stations. It may be assumed that any one of the several observers would have published an account of a mixed incipient colony of *obscuripes* had one been discovered. Yet, as far as I have been able to determine, no such observation has ever been published. I am aware that the data just presented will not disprove Wheeler's postulate. The incipient mixed nests of *obscuripes* may be excessively rare or they may be very evanescent with the host workers replaced by those of the intruder as soon as the *obscuripes* brood emerges. But it seems certain that whatever the situation may be, it is not the simple matter which Wheeler assumed to be the case in 1910. If nothing more were involved than the usual type of temporary social parasitism, we should by now have had evidence not only in the case of *obscuripes* but also for other species as well. For with those species which have been proven to be temporary social parasites (*dakotensis, exsectoides, ulkei, microgyna* etc.) it has not been unusually difficult to find young mixed colonies even when the total number of nests examined has been far less than that in the case of some of the species in the *rufa* group.

I confess that I find it hard to believe that all the species in the *rufa* group are temporary social parasites. There need be no disagreement in the case of such species as *ciliata, comata, criniventris* and *oreas* for these species have very aberrant females and it would be surprising if the extraordinary pilosity which they possess were not in some way connected with a parasitic type of nest-founding. But many of the females in the *rufa* group are not marked by any such peculiarities. They are perfectly normal, full-sized insects with bulky thoraces and, as far as structure is concerned, they seem entirely capable of founding their colonies unaided. That such females have been successfully introduced into captive, queenless colonies of a 'host' species does not, in my opinion, establish the fact that their normal behavior must take the same course. It would seem more to the point to isolate females of *integra, obscuripes, obscuriventris, coloradensis* etc., and observe what happens in the absence of any workers. Then, at least, we would have evidence that these species can or cannot found their colonies alone.

Before presenting the key to the *rufa* group I wish to comment on one of its features. Several of the species in the *rufa* group are more easily and certainly recognized from the female than from the worker. It happens that in most of these cases the females involved are of an aberrant type. If, therefore, the females are keyed out separately, it does not follow that the key to the females will be a close counterpart of that of the workers. Thus by dissociating the females from

the workers their usefulness as an aid to determining the worker is diminished. It appears to me that the inclusion of female characteristics in a worker key might be justified under such circumstances. It is impossible to key the females when they are treated in this fashion and I must admit that it makes the worker key rather cumbersome. But at least the distinctive characters of the female are noted in the places where they can be of most service For those species which carry no characterization of the female, it may be assumed that the caste is of the normal type and lacks aberrant characteristics. It may be added, for the benefit of those who will wonder what has become of *F. foreliana*, that this species has proven to be a synonym of *F. rufibarbis gnava*.

Key to the species in the rufa group

1. Crest of the petiole extremely thick and evenly rounded above so that in profile the scale has the shape of an inverted letter U; hairs forming the gastric pubescence often erect at the base but reflected at the tip so that they form little loops or wickets (female 5.5 mm.–6.5 mm. in length, very smooth and shining and with a gastric pubescence like that of the worker) *reflexa*

   Crest of the petiole much thinner; in profile the anterior face slopes rearward to the crest even when the latter is blunt; gastric pubescence usually appressed and never reflected 2
2. Antennal scapes covered on all surfaces with numerous, delicate, erect or suberect hairs (female very smooth and shining, orange in color and with numerous small erect hairs on all parts of the body) 3

   Antennal scapes without erect hairs except for those at the extreme tip, rarely a few scattered suberect hairs on the inner surface near the tip . . . 4
3. Minor workers not extensively infuscated, the head and thorax in large part, or entirely, clear red as in the larger workers . . . . . *oreas*

   Minor workers extensively infuscated, the head and thorax in large part deep brown, their color distinctly darker than that of the larger workers *oreas* subsp. *comptula*
4. Scale of the petiole seen from behind with a flat or broadly concave crest, the sides in the upper half of the scale parallel, tapering inward only in the lower half of the scale (female sometimes no larger than the largest worker, strongly shining, color dull brown with some yellow markings) . . 5

   Scale of the petiole seen from behind with the crest convex or angularly produced upward in the middle, rarely with a small central notch; the sides of the scale tapering inward evenly from crest to peduncle 6
5. Erect hairs present on the gula and crest of the petiole; head and thorax clear yellowish red or ferrugineous . . . . . *dakotensis* subsp. *montigena*

   Erect hairs absent on the gula and crest of the petiole; color decidedly variable, head and thorax deep ferrugineous red to deep blackish red . . . . *dakotensis*

6. Median lobe of the clypeus descending abruptly to the clypeal fossae through steep side faces which make an angle with the upper face of the lobe; clypeal fossae deep and pit-like, the anterior edge of the clypeus which bounds them in front, sweeping up in an even curve to the median lobe.....7
Median lobe of the clypeus descending to the clypeal fossae through an even curve which begins at the carina; the clypeal fossae shallow and scarcely pit-like, the edge of the clypeus in front of the fossa very broadly united to the base of the lobe and not forming a distinct curve with it..10
7. Middle and hind tibiae without erect hairs except for a double row on the flexor surface.....8
Middle and hind tibiae with many erect hairs on all surfaces.....9
8. Erect hairs absent on the upper surface of the body; gaster with extremely fine, short, scattered pubescence, its surface strongly shining (female sometimes no larger than the largest worker; virtually hairless and very strongly shining; its clypeus ecarinate.....*fossaceps*
Erect hairs abundant on the upper surface of the body; gaster opaque with rather dense whitish pubescence (female always larger than the largest worker; thorax less shining than the head and gaster; erect hairs present; clypeus ecarinate).....*laeviceps*
9. Minor workers extensively infuscated with brown, majors and medias with at least the scale of the petiole infuscated..*obscuriventris* subsp. *clivia*
Minor workers less deeply infuscated, dirty yellowish brown in color, scale of the petiole in the majors clear red or yellow.....*obscuriventris*
10. Erect hairs on the middle and hind tibiae, when present, confined to a double row of bristles on the flexor surface, rarely one or two erect hairs elsewhere.....13
Erect hairs on the middle and hind tibiae usually abundant and covering all surfaces but at least there are a number of erect hairs in addition to those on the flexor surface.....11
11. Head of the major as broad as long or broader than long (mandibles excluded); erect hairs on the thorax rather unequal in length; cephalic hairs only a little less abundant and not much longer than those on the thorax.....*obscuripes*
Head of the major longer than broad (mandibles excluded); erect hairs on the thorax short and of about equal length; cephalic hairs notably longer and sparser than those on the thorax.....12
12. Smaller workers extensively infuscated with brown, medias more or less marked with brown, legs in all sizes of worker brownish black.....
integroides subsp. *planipilis*
Head and thorax of all workers, except an occasional minim, clear red, the legs scarcely or not at all darker than the thorax.....
integroides subsp. *coloradensis*
13. Gaster densely clothed with short, erect hairs which are close enough together to give the appearance of a loose, plush-like investiture when the gaster is viewed in profile.....14
Erect hairs on the gaster much more widely spaced and not forming an even investiture when the gaster is viewed in profile.....16

14. Gula usually without any erect hairs; rarely one or two suberect hairs present (female yellow with very long, yellow hairs with curled tips present on the pronotum, scutellum, fore coxae, mesosternum, epinotum, scale of the petiole and the entire gaster) ..... *ciliata*
Gula with several erect hairs, usually at least a dozen present 15
15. Erect hairs on the gaster very short, averaging about .06 mm. in length (female brownish yellow with a brown gaster, pilosity like that of *ciliata* but the long hairs on the gaster are greyish and not curled at the tip) *comata*
Erect hairs on the gaster longer, averaging about .12 mm. in length (female dirty brown, largely opaque, dorsum without erect hairs, densely pubescent, the pubescence erect on occiput, genae and scutellum, semi-erect on the scutum and the base of the gaster) ..... *mucescens*
16. The row of erect bristles on the middle and hind tibiae extending at least one half the length of the tibia 17
Middle and hind tibiae virtually without erect hairs of any sort, the usual row of erect bristles reduced to three or four hairs close to the spur; erect body hairs completely absent except on the clypeus and gaster (female deep yellow, shining; long hairs with curled tips abundant on gaster and crest of the petiole, sparse on epinotum, scutellum, pronotum and clypeus) *criniventris*
17. Scale of the petiole low and thick from front to back, the crest blunt and not extending above the level of the epinotal spiracle when the scale is in a vertical position 18
Scale of the petiole thinner from front to back, higher and with a sharper crest, which in the majors and medias distinctly exceeds the level of the epinotal spiracle when the scale is in a vertical position 19
18. Dorsum of the gaster with numerous, delicate erect hairs; cheeks with distinct, coarse, oval punctures between the front of the eye and the insertion of the mandible (female unknown but probably aberrant) .... *ferocula.*
Dorsum of the gaster with scarcely any erect hairs, a few present at the base and tip; cheeks densely and finely coriaceous but without distinct punctures (female golden yellow, the gaster banded with brown; long hairs with curled tips abundant on ventral surface of the gaster, clypeus, coxae, fore femora and entire thorax except the scutum ..... *prociliata*
19. Head of the largest workers as broad as long (mandibles excluded) ..... *obscuripes* subsp. *ravida*
Head of the largest workers longer than broad (mandibles excluded) ... 20
20. Clypeus, gula and genae strongly shining ..... *integroides* subsp. *subnitens*
Clypeus, gula and genae subopaque or completely opaque 21
21. Gula, crest of the petiole and dorsum of the thorax usually without erect hairs, rarely one or two inconspicuous hairs present 22
Numerous erect hairs present on gula, pronotum, epinotum and crest of the petiole at least in a considerable part of a nest series 24
22. Head and thorax of the minor worker in large part or entirely blackish brown, medias with dark blotches on the head and thorax ..... *integra* subsp. *tahoensis*

Head and thorax never infuscated in the majors and medias and only rarely in the minors; infuscation, when present, light brown.....23

23. Eyes hairy; gaster opaque with dense grey pubescence..... *integra* subsp. *haemorrhoidalis*

Eyes hairless; gaster feebly shining with delicate, dilute pubescence... *integra*

24. Occipital angles always without erect hairs...*integroides* subsp. *propinqua*

Occipital angles with erect hairs at least in a considerable part of a nest series.....25

25. Gaster uniform black or deep brown.....*integroides*

Gaster with a reddish area at the base of each segment..... *integroides* subsp. *subfasciata*

20. Formica ciliata Mayr

F. ciliata Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 428 (1886) ♀; Emery, Zool. Jahrb. Syst., Vo. 7, p. 655, pl. 22, fig. 12 (1893) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 19, p. 640, fig. 1 (1903) ♀ ♀ ♂; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 452 (1913) ♀ ♀ ♂.

Type loc: female, Colorado; worker and male, Ute Pass, Manitou, Colorado.

Types: female, none in this country; worker, A.M.N.H., M.C.Z.

Range: Colorado and Utah north to Montana and east to Minnesota.

The nests of *ciliata* are generally built in meadows or very open woods. The nests are extensively thatched but the thatching is only rarely built into a mound. In the latitude of central Colorado *ciliata* occurs at elevations between 7000 and 8500 feet.

21. Formica comata Wheeler

F. comata Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 85 (1909) ♀ ♀ ♂; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 454 (1913) ♀ ♀ ♂.

Type loc: Manitou, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: Colorado to South Dakota.

22. Formica criniventris Wheeler

F. crinita Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 87 (1909) ♀ ♀ (*nec* F. Smith).

F. criniventris Wheeler (*nomen novum*), Psyche, Vol. 19, p. 90 (1912); Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 457 (1913) ♀ ♀.

Type loc: Boulder, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: Colorado north to Montana and east to the Dakotas.

23. Formica dakotensis Emery

F. dakotensis Emery, Zool. Jahrb. Syst., Vol. 7, p. 652 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl., Vol. 53, No. 10, p. 462 (1913) ♀ ♀.

F. subpolita var. *specularis* Emery, Zool. Jahrb. Syst., Vol. 7, p. 663 (1893) ♀.

F. dakotensis var. *wasmanni* Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 153 (1904) ♀ ♀ ♂.

F. dakotensis var. *specularis* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 464 (1913) ♀ ♀ ♂.

F. dakotensis var. *saturata* Wheeler, Proc. Amer. Acad. Arts Sci., Vol. 52, No. 8, p. 542 (1917) ♀.

Type loc: Hill City, South Dakota. Types: A.M.N.H.

Host (temporary): *F. fusca.*

Range: south central Ontario west to Montana and the Black Hills of South Dakota.

Wheeler recorded *dakotensis* from Nova Scotia and British Columbia. What the first record may have been I am unable to say but the specimens from British Columbia are plainly the subspecies *montigena.* It seems probable that the typical *dakotensis* does not occur east of Georgian Bay or west of the Rockies. In my opinion it is out of the question to defend the validity of the varieties *specularis* and *saturata.* The first was originally established by Emery as a variety of *subpolita.* The types of *specularis* were two females, one taken by Pergande in the Black Hills of South Dakota, the other secured by Wasmann in Wisconsin. This circumstance contributed largely to the taxonomic tangle which followed, for Emery was unable to associate the rather aberrant female of *dakotensis* with the worker of that species and so made *specularis* a variety of *subpolita.* Some time later Wasmann received more material from Muckermann and this material, taken in Wisconsin, contained both sexual forms and workers. Wasman turned it over to Forel, who told him that it was *dakotensis,* but sent specimens to Emery for certification. Thus Wasmann published on this material under the name *dakotensis* in 1901 and thereby achieved the undeserved distinction of being the only myrmecologist who has treated this material correctly. In due course Emery gave Forel a report on Muckermann's specimens. They were undoubtedly *dakotensis* and this solved the difficulty of the erroneous association of the female of *specularis* with *subpolita.* But Emery was unwise enough to note certain slight differences in the Muckermann specimens. This was enough for Forel, who used these differences as the basis for the erection of the variety *wasmanni.* Since Forel included Emery's observations in the form of a note, it is not altogether clear as to who should be regarded as the author of the variety *wasmanni,* but it makes little difference for the significant point is not the matter

of authorship but the fact that the Muckermann specimens had been established as being different from those on which the typical *dakotensis* was based.

This was the situation when Wheeler tackled the problem of *dakotensis* in 1913. It is instructive to note what authentic material Wheeler had at that time. He had a single worker cotype of *dakotensis* which Emery had sent him. He had a series of specimens collected by Muckerman in Wisconsin. It is by no means certain that these were a part of the nest series which Muckermann sent to Wasmann but Wheeler evidently believed them to be so. If this point is allowed, then Wheeler had authentic material of the variety *wasmanni*. Since this material contained all three castes, Wheeler was in almost exactly the same position as Emery when the latter investigator had received specimens of Muckermann's Wisconsin material from Forel. If Emery had noted differences in this material Wheeler could scarcely do less, but he avoided Forel's mistake of using these differences as the basis for a new variety. Instead he attributed them to the variety *specularis* and made Forel's *wasmanni* a synonym of that form. Wheeler further made a logical but unfortunate distinction between the two type females of *specularis*. Emery had noted a very slight color difference in his original description of the two. This enabled Wheeler to assign Pergande's specimen to *dakotensis*, a move which was certainly defensible, since it and the workers of *dakotensis* had both been taken in the Black Hills.

I have presented an account of these erudite and complicated taxonomic maneuvers because I do not wish to be considered dogmatic in the stand which I have taken in this matter. I submit that all the fumbling and fussing that surrounded *dakotensis* and its varieties *wasmanni*, *specularis* and *saturata* might have been avoided if any one of the several individuals involved had realized that the typical *dakotensis* is a species whose color and whose pubescence are subject to variation. As soon as this is appreciated most of the inconsistencies are easily resolved. It is not surprising that Wheeler's attempts to give distinctive cephalic characters to *specularis* or a size difference to *saturata* proved abortive, for in each case he was dealing with the typical *dakotensis*. What may be regretted is that Wheeler's lack of any clear idea of the nature of the typical form considerably damaged his treatment of the very distinct subspecies *montigena*. As I have already noted, Wheeler confused this form with the typical *dakotensis* and his key characters were so worded that no clear distinction can be made between the two insects. I have discussed this matter under the subspecies *montigena*. Whatever view one may take of the varieties *specularis* and *saturata*, it is certain that they can only be defended

as color variants. It is also certain that neither of them behave as geographical races. I have, for this reason, treated both as synonyms of *dakotensis*.

24. Formica dakotensis montigena Wheeler

F. montigena Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 374 (1904) ♀ ♀ ♂.

F. dakotensis var. *montigena* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 463 (1913) ♀ ♀ ♂.

Type loc: Ute Pass, Colorado. Types: A.M.N.H., M.C.Z.

Range: New Mexico north to British Columbia. In the southern parts of its range *montigena* occurs at 8000 feet or higher. In the northern part of the range the elevation is between 5000 and 6000 feet. Its range meets that of the typical *dakotensis* in western Montana.

Hosts (temporary): *F. fusca*, *F. pallidefulva*.

Gregg has recently (1946) reported *montigena* from Minnesota but it seems probable that this record applies to the typical *dakotensis*. It is not surprising that there should have been confusion between the two forms. Wheeler's 1913 key is so worded that very few specimens of the typical *dakotensis* will run out to their proper place. Wheeler brought out *dakotensis* on a couplet which stated that erect hairs are absent on the gula, upper surface of the head, thorax and petiole. In contrast, *montigena* was said to possess erect hairs on these parts. What Wheeler had in mind here is hard to say, for his description of the typical *dakotensis* noted the presence of erect hairs in some specimens. In the opinion of the writer such hairs are usually present on the dorsum of the head, the pronotum and the gaster in the typical *dakotensis*. They are, however, absent on the gula and the crest of the petiole in that form and this gives a good distinction between it and the subspecies *montigena*, which has erect hairs on the crest of the petiole and the gula as well as those elsewhere.

25. Formica ferocula Wheeler

F. ferocula Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 461 (1913) ♀.

Type loc: Rockford, Illinois. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: known only from type material.

In 1913 Wheeler surmised that *ferocula* is allied to *ciliata* and that its female would prove to be not unlike that of the latter species.

Wheeler's guess seems to have been very accurate for, while the female of *ferocula* is still undiscovered, we now have confirmatory evidence from another species, *prociliata*. This species is even more closely related to *ferocula* than is *ciliata* and has a most remarkable hairy female. We may, therefore, expect that when the female of *ferocula* is discovered, we will have added another extraordinary pilose female to those already known.

26. Formica fossaceps Buren

F. fossaceps Buren, Iowa State Coll. Jour. Sci., Vol. 16, No. 3, p. 402, (1942) ♀ ♀ ♂.
Type loc: Winterset, Iowa. Types: Coll. Buren. Paratypes: U.S.N.M., Coll. Iowa State College, Coll. W. S. Creighton.
Range: known from Iowa only.

This unusually beautiful and interesting species is the only known representative of the *rufa* group whose female is no larger than the largest worker. Although it might be thought that this circumstance would indicate a relationship with the *microgyna* group, this is not the case. Despite its small female, *fossaceps* clearly belongs to the *rufa* group and its unusual clypeal structure indicates a close relationship with such species as *laeviceps* and *obscuriventris*. The small, almost hairless and highly shining female of *fossaceps* makes its identification easy if that caste is available for examination.

27. Formica integra Nylander

F. integra Nylander, Ann. Sci. Nat. Zool. (4), Vol. 5, p. 62 (1856) ♀.
F. rufa subsp. *integra* Emery, Zool. Jahrb. Syst., Vol. 7, p. 652, pl. 22, figs. 4, 8 (1893) ♀ ♂; Forel, Ann. Soc. Ent. Belg., Vol. 57, p. 361 (1913); Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.
F. truncicola subsp. *integra* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 444 (1913) ♀ ♀ ♂.
F. integra var. *similis* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 425 (1886) ♀ ♀ ♂.
Type loc: 'North America'. Types: none in this country.
Range: eastern North America from Nova Scotia to northern Georgia and Alabama and west to the Black Hills of South Dakota.

For the revisionary data on *F. integra* see the discussion at the beginning of the Subgenus Formica.

28. Formica integra haemorrhoidalis Emery

F. rufa subsp. *integra* var. *haemorrhoidalis* Emery, Zool. Jahrb. Syst., Vol. 7, p. 652 (1893) ☿.

F. truncicola subsp. *integroides* var. *haemorrhoidalis* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, p. 441 (1913) ☿ ♀ ♂.

F. rufa subsp. *haemorrhoidalis* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ☿.

Type loc: Colorado (by Wheeler's 1913 restriction). Types: M.C.Z.

Range: mountains of Colorado and Utah northwest to Washington and east to the Black Hills of South Dakota.

Although Wheeler was very positive that *haemorrhoidalis* belongs to *integroides* rather than to *integra*, it would seem that Emery's original view is more nearly correct. The sculpture of the female of *haemorrhoidalis* is more like that of *integra* than that of *integroides* and I believe that this counts for more than the matter of gastric pubescence in determining relationship in this case. The sculpture of the *integra* female is given in the discussion at the beginning of the subgenus Formica.

29. Formica integra tahoensis Wheeler

F. truncicola subsp. *integroides* var. *tahoensis* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 538 (1917) ☿ ♀.

F. rufa subsp. *tahoensis* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ☿.

Type loc: Lake Tahoe, California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: mountains of eastern Nevada to the western slopes of the Sierras.

The structure of the worker of *tahoensis* is very similar to that of *haemorrhoidalis*. Indeed, the only significant difference in the two appears to lie in the infuscation of *tahoensis*. The nests of the two subspecies are very much alike. They are usually built under logs which are banked with a moderate amount of thatching.

30. Formica integroides Emery

F. rufa subsp. *obscuriventris* var. *integroides* Emery, Zool. Jahrb. Syst., Vol. 7, p. 649 (1893) ☿.

F. truncicola subsp. *integroides* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 438 (1913) ☿ ♀.

F. rufa subsp. *integroides* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ☿.

F. truncicola subsp. *integra* var. *subcaviceps* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 540 (1917) ♀ ♂.

F. rufa subsp. *subcaviceps* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.

Type loc: Mt. Shasta, California. Types: A.M.N.H., M.C.Z.

Range: coastal mountains of California and the western slopes of the Sierras north to Washington.

In recent years I have had the opportunity to examine material of *integroides* which was not available when I published my 1940 paper on the *rufa* variants. Some of this material consisted of specimens referred to *integroides* by Wheeler in 1913 and 1917. The variability in this material was exceedingly discouraging. It seemed to indicate clearly that it is impossible to recognize *subcaviceps* as a separate form, for specimens referable to that variant occurred in almost every nest series which Wheeler had identified as the typical *integroides*. This, however, is by no means the most serious difficulty involved. The variability of the pattern of erect hairs is so great that it defeats any attempt to arrive at what constitutes the 'typical' *integroides*. I noted this variability in my 1940 paper but at that time I thought it due to intergradation at the northern end of the range of *integroides*. It now appears that *integroides* is equally variable in all parts of its range. This, of course, makes the form very difficult to handle in a key. While I have followed Wheeler in assuming that the 'typical' *integroides* has erect hairs on the occipital angles, it should be borne in mind that it is often possible to find nest series in which the majority of the workers lack such hairs. The status of *integroides* is highly problematical and, since it shows much less constancy in hair pattern than do some of its subspecies, one may wonder if the 'typical' form is not actually an intergrade. The problem cannot be solved until we know more about the occurrence of *integroides* in the southern parts of the Coastal Range. There, if anywhere, one might expect to find a pure population of the 'typical' form. For other revisional data on *F. integroides* see the discussion at the beginning of the Subgenus Formica.

31. Formica integroides coloradensis Wheeler

F. truncicola subsp. *integroides* var. *coloradensis* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 440 (1913) ♀ ♀.

F. rufa subsp. *coloradensis* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.

Type loc: Florissant, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: New Mexico to Idaho with the main part of the range lying in the mountains of Colorado and Utah.

32. Formica integroides planipilis Creighton

F. rufa subsp. *planipilis* Creighton, Amer. Mus. Novitates, No. 1055, p. 9, fig. 1 (1940) ♀.
Type loc: Mt. Wheeler, Nevada. Types: A.M.N.H. Paratypes: Coll. W. S. Creighton.
Range: mountains of eastern Nevada at elevations of 7500–8500 feet.

The intergrades between *planipilis* and *obscuripes* mentioned in my 1940 paper I now regard as connecting *planipilis* and *coloradensis*.

33. Formica integroides propinqua Wheeler

F. truncicola subsp. *integroides* var. *propinqua* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 538 (1917) ♀.
F. rufa subsp. *propinqua* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.
Type loc: Lake Tahoe, California. Types: A.M.N.H., M.C.Z., Coll W. S. Creighton.
Range: central California north to Washington along the eastern slopes of the Sierras and Cascade Mountains.

34. Formica integroides subnitens Creighton

F. rufa subsp. *subnitens* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 10, fig. 1 (1940) ♀.
Type loc: Bly, Oregon. Types: A.M.N.H. Paratypes: Coll. W. S. Creighton, Coll. A. C. Cole.
Range: known only from type material.

The status of *subnitens* is problematical and will remain so until the female is discovered. The shape of the head in *subnitens* agrees very well with *integroides*. But the clypeus, gula and genae of *subnitens* are strongly shining and this suggests a relationship to *laeviceps* rather than to *integroides*. Since *subnitens* is so little known it is impossible to generalize about its habits but it seems worth noting that the type nest was fully exposed with no covering mound of detritus.

35. Formica integroides subfasciata Wheeler

F. truncicola subsp. *integroides* var. *subfasciata* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 539 (1917) ♀.
F. rufa subsp. *subfasciata* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.

Type loc: Wilson Peak, San Bernardino Mts., California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: known only from type material.

I have retained *subfasciata* as a valid subspecies although it may be doubted that its validity will be defensible when more material is available for examination. The main difference between this form and *integroides* is one of gastric coloration. Each gastric segment of *subfasciata* is supposed to have a reddish blotch near the base. It must be confessed that this difference is not particularly striking in the type specimens but it is possible that fresh material would show a better distinction. From a distributional standpoint there is no reason why *subfasciata* might not be a valid geographical race for its range lies to the south of that of *integroides*.

36. Formica laeviceps Creighton

F. rufa subsp. *laeviceps* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 9, fig. 1 (1940) ♀ ♀.
Type loc: Warner Ranger Station, La Sal Mts., Utah. Types: A.M.N.H. Paratypes: Coll. W. S. Creighton, Coll. A. C. Cole.
Range: known only from type material.

The type nest was taken on a fully exposed, stony slope at an elevation of 8500 feet. The nest was beneath a stone which was banked with detritus. For revisionary data on *F. laeviceps* see the discussion at the beginning of the Subgenus Formica.

37. Formica mucescens Wheeler

F. truncicola subsp. *mucescens* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 442 (1913) ♀ ♀ ♂.
F. rufa subsp. *mucescens* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.
Type loc: Colorado Springs, Colorado. Types: M.C.Z., A.M.N.H., Coll. W. S. Creighton.
Range: mountains of Colorado and Utah at elevations up to 8500 feet.

The female of *mucescens* is a distinctive and rather aberrant insect. The characteristics of this caste and the reasons for according *mucescens* specific status have been given in the discussion at the beginning of the Subgenus Formica.

38. Formica obscuripes Forel

F. rufa subsp. *obscuripes* Forel, Ann. Soc. Ent. Belg., Vol. 30, C.R. p. 29 (1886) ♀; Forel, Deutsche Ent. Zeitschr., p. 619 (1914); Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 433 (1913) ♀; Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.

F. rufa McCook, Proc. Acad. Nat. Sci. Phila., p. 57 (1884).

F. rufa subsp. *obscuriventris* var. *rubiginosa* Emery, Zool. Jahrb. Syst., Vol. 7, p. 650 (1893) ♀ (not ♀).

F. rufa subsp. *aggerans* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 430 (1913) ♀ ♀ ♂.

F. rufa subsp. *obscuriventris* var. *melanotica* Emery, Zool. Jahrb. Syst., Vol. 7, p. 650 (1893) ♀.

F. rufa subsp. *aggerans* var. *melanotica* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 432 (1913) ♀ ♀ ♂.

F. rufa subsp. *obscuripes* var. *melanotica* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 537 (1917).

F. rufa subsp. *obscuripes* var. *melanotica* Weber, Ecological Monographs, Vol. 5, No. 2, p. 171 (1935).

F. rufa subsp. *melanotica* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.

Type loc: Green River, Wyoming. Types: M.C.Z.

Range: northern Illinois and Wisconsin northwestward to Washington and British Columbia. There is a considerable southern extension in the Rocky Mountain Region where the insect reaches southern Colorado. But it does not follow down the Sierras in California. It is rare in Oregon and apparently absent in California, although Wheeler published one record from Lake Tahoe.

After much effort to arrive at a satisfactory basis for the recognition of *melanotica*, I have concluded that Dr. Weber was correct when he treated the variant as a synonym of *obscuripes* in 1935. The observations which Dr. Weber presented on the color of *obscuripes* and *melanotica* are, in my opinion, only a part of the problem for, in addition to its darker coloration, there are other slight differences which mark *melanotica*. The gaster is a little more shining, the erect body hairs are slightly shorter and the middle and hind femora are often more coarsely punctured than those of *obscuripes*. If there were any significant difference in the range of the two insects, there would be every reason to consider *melanotica* a geographical race. Actually there appears to be no difference whatever in their ranges and, as Dr. Weber pointed out, the two forms not infrequently nest in close proximity. Since it seems out of the question to accord *melanotica* specific status on the basis of the very slight differences which separate this form from *obscuripes* and since *melanotica* is clearly not a geographical race, it has been treated here as a synonym of *obscuripes*. For additional

revisionary data on *F. obscuripes* see the discussion at the beginning of the Subgenus Formica.

39. Formica obscuripes ravida Wheeler

F. truncicola subsp. *integroides* var. *ravida* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 560 (1913) ♀ ♀.
F. rufa subsp. *ravida* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.
Type loc: Elkhorn, Montana. Types: M.C.Z.
Range: mountains of western Montana.

The status of *ravida* is problematical. It is clearly related to *obscuripes* for it has the characteristic cephalic structure that marks that species. On the other hand, it is hard to see how *ravida* can be a geographical race unless its range is separated from that of *obscuripes* by an elevational difference. For the range of *ravida* is completely surrounded by that of *obscuripes*. I doubt that there is any significant elevational difference in the case of *ravida* but too little is known about *ravida* at present to permit a positive statement on this point. When *ravida* is better known it seems probable that it will prove to be nothing but a nest variety of *obscuripes*.

40. Formica obscuriventris Mayr

F. truncicola var. *obscuriventris* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 951 (1870) ♀.
F. rufa subsp. *obscuriventris* Emery, Zool. Jahrb. Syst., Vol. 7, p. 649 (1893) ♀; Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1(1940) ♀.
F. truncicola subsp. *obscuriventris* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 445 (1913) ♀ ♀ ♂.
F. dryas Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 268 (1905) ♀ ♀.
F. dryas var. *gymnomma* Wheeler, Ibid., Vol. 21, p. 269 (1905) ♀.
F. rufa subsp. *gymnomma* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 3, fig. 1 (1940) ♀.
Type loc: Connecticut. Types: none in this country.
Range: southern Canada and New England south to Virginia and west to Wisconsin and the Black Hills of South Dakota. Also occurs sporadically at considerable elevation in the southern Rockies.

Although *gymnomma* has been treated as a synonym of *obscuriventris* in the present work, I confess that this treatment leaves much to be desired. The characteristics of *gymnomma* are puzzling in several respects. It has, and this is true even of the type series, a notably variable pilosity. There are some specimens which are fully as hairy as

obscuriventris, even to the small hairs on the eyes. There are others which are almost as hairless as *integra.* It is clear that Wheeler had these less hairy individuals in mind when he described *gymnomma.* But since this condition never holds for an entire colony, it follows that *gymnomma* can only be recognized by splitting nest series. It is interesting to note that this same variability is occasionally encountered in colonies of *clivia.* I believe that this is what Buren had in mind when he described the hairs of *clivia* as 'deciduous'. In general, however, both *obscuriventris* and *clivia* are quite constant in hair pattern. It seems to me that this is more important than the fact that an occasional colony will show a variable hair pattern. I can see nothing to be gained by giving a name to these exceptional cases, especially when they are always marked by some individuals which possess the typical pilosity.

41. Formica obscuriventris clivia Creighton

F. rufa subsp. *clivia* Creighton, Amer. Mus. Nat. Hist. Novitates, No. 1055, p. 8, fig. 1 (1940) ☿ ♀ ♂.

Type loc: Fish Creek Ranger Station, Glacier National Park, Montana. Types: A.M.N.H. Paratypes: Coll. W. S. Creighton.

Range: Wisconsin and Iowa west to British Columbia with a southern extension in the foothills of the Rockies to Colorado.

42. Formica oreas Wheeler

F. oreas Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 19, p. 643 (1903) ☿ ♀ ♂; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 458 (1913) ☿ ♀ ♂.

Type loc: Ute Pass, Manitou, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: northern New Mexico to Montana. It would appear that the type locality (Ute Pass, 8500 feet) is the highest known elevational record for the species. It is more commonly found at levels between 6000 and 7000 feet.

The nests of *oreas* are usually covered with much detritus and under favorable conditions it builds this into sizeable mounds quite like those of *obscuripes.* The insect prefers to nest in open meadows or plains and the colonies are often very abundant.

43. Formica oreas comptula Wheeler

F. oreas var. *comptula* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 460 (1913) ☿ ♀.

Type loc: Pullman, Washington. Types: M.C.Z.

Range: northwestern Iowa west through Montana and southern Alberta to Washington.

Wheeler was of the opinion that *comptula* is more hairy than the typical *oreas* but it has been my experience that the average nest series shows too much variation in pilosity to give this distinction much value. The darker color of *comptula* is, on the other hand, a very satisfactory character for purposes of separation since it is constant and can be correlated with the distribution of this northern race.

44. Formica prociliata Kennedy & Dennis

F. prociliata Kennedy & Dennis, Ann. Ent. Soc. Amer., Vol. 30, p. 531, figs. 1–9 (1937) ☿ ♀ ♂.
Type loc: Catawba Point (Port Clinton), Ohio. Types: Coll. Kennedy. Paratypes: Coll. W. S. Creighton.
Range: Ohio to Iowa.

This striking and beautiful species is most easily recognized from the female. Some of the distinctive features of the female of *prociliata* have been given in the key but it seems worth while to add other details here. The dorsum of the gaster in the virgin female appears greyish because of a rather dense, appressed pubescence. This rubs away in the older females (as do many of the long hairs) leaving the gastric dorsum smooth and shining and revealing the very distinct brown band on each segment. The type material of *prociliata* was taken from a number of nests which were built under stones on ledges in open woods. The nests lacked any thatching and since they all were uniform in this regard it seems safe to assume that *prociliata* constitutes an exception to the general rule of thatching in the *rufa* group.

45. Formica reflexa Buren

F. reflexa Buren, Iowa State Coll. Jour. Sci., Vol. 16, No. 3, p. 399 (1942) ☿ ♀ ♂.
Type loc: Hibbing, Minnesota. Types: Coll. W. F. Buren. Paratypes: U.S.N.M., Coll. Iowa State College, Coll. W. S. Creighton.
Host (permanent?): *F. fusca*.
Range: northern Minnesota to Iowa.

This extraordinary insect is marked by so many unique characteristics that it could scarcely be confused with any other species in the *rufa* group. One of its most striking peculiarities is its very small

female, which is no larger than those of several of the species in the *microgyna* group. It is probably this fact that led M. R. Smith to treat *reflexa* as a member of that group in his 1947 generic monograph. The writer, however, agrees with Buren that *reflexa* cannot be regarded as a member of the *microgyna* group. Despite the small size of the female, *reflexa* is closely related to *dakotensis* and this view is borne out by the structure of the male, which is very similar to the male of *dakotensis* but not at all like the males of the *microgyna* group. If Buren is correct, the habits of *reflexa* are no less remarkable than its structure. The insect can scarcely be a temporary social parasite, for in all five colonies which Buren discovered the workers of the host species, *F. fusca*, considerably outnumbered those of *reflexa*. The small size and the timidity of the *reflexa* worker seem to rule out the possibility that they might be slave-makers. Hence Buren concludes that *reflexa* must be a permanent inquiline. This conclusion appears to be thoroughly justified and one wonders whether a similar explanation may not apply to the mixed colonies of *dakotensis* which have previously been explained on the basis of temporary social parasitism.

Species belonging to the *microgyna* group

When Carlo Emery called the first described member of the *microgyna* group *difficilis*, his choice of name was prophetic, not only for that species but for the group as a whole. It is seldom that one encounters an assemblage of species in which the taxonomy is so consistently difficult. Much of this difficulty can be attributed to the fact that half the described forms in the *microgyna* group have been treated as infraspecific variants of *microgyna* itself. There is nothing unique about this situation, for it parallels the aggregations which have grown up around such species as *rufa* and *sanguinea*. But with *microgyna* there is one rather disturbing difference. The species has been made to include variants whose characteristics are often quite as distinct as those of other forms in the *microgyna* group which have been given full specific status. The reason for this inconsistency appears to lie in certain peculiarities of the diminutive females which mark this group. Not only are these little insects notable for their small size but also for a rather marked degree of convergence of form. It is ordinarily true that the structure of the female is more conservative than that of the worker and this fact has been widely employed as a check on specificity in cases where there is doubt as to the significance of structural features shown by the worker. We have, therefore, come to accept female structure as a conclusive proof of specificity

and one which can be relied upon to make up for any deficiency which may be shown by the worker caste. It happens that the *microgyna* group is the exception which proves the above rule. In many instances it is easier to find separatory characters in the worker than in the female. It should not be thought that the females of the *microgyna* group lack sound specific characters, for this is not true, but these characters are often much more subtle than is the case with the ordinary female. When one has become accustomed to dealing with the differences which the female ordinarily shows, it is easy to underestimate the less obvious differences exhibited by the microgynous female. It seems to me that this is exactly what has occurred in Wheeler's treatment of *microgyna*. He was willing to include distinctly different workers within the limits of that species because he was not satisfied that the females of those workers showed specific differences. Indeed, in 1917 Wheeler was ready to consider the possibility that *microgyna* might have to be expanded to include *whymperi* and its variants.

It would seem that there is little hope for arriving at a satisfactory treatment for the *microgyna* group unless allowance is made for the structural peculiarities of the diminutive females. To demand that these little insects show the same structural distinctness that marks the ordinary female is to ask the impossible. Such a course must inevitably lead to the formation of heterogeneous assemblages of workers such as one finds at present in *microgyna*. But if distinct and constant structural differences in the worker caste are made the basis for specific delimitation, then it is not too difficult to find accompanying differences in the case of the female and the taxonomy of the *microgyna* group falls into line with that in the rest of the genus Formica.

All the species of the *microgyna* group are believed to be temporary social parasites. Such a conclusion is made necessary by the diminutive female, which could scarcely found a nest alone because of lack of adequate thoracic musculature. While little is known about the actual process of nest-founding, it seems clear that the female in some way secures adoption by the workers of the host species. As to whether she kills the host female is not known, but that individual is obviously eliminated in some fashion. It seems probable that the host workers remain in the colony for a considerable time after the intruding queen has established her own brood. But the host workers ultimately die off, hence the fully developed colony of a species belonging to the *microgyna* group never contains workers of the host species. As a rule the colonies are of moderate size and, while many of the species make considerable use of thatching, they rarely produce large mounds. More often the thatching is scattered about the nest openings in a

flattened disc or fan. Most of the species prefer to nest in open woods or meadows but *F. whymperi adamsi* is said to nest in sphagnum bogs.

The following key does not contain the species *scitula* and *nevadensis* which are known only from females. The species *densiventris* has also been omitted for reasons discussed on a subsequent page.

Key to the species of the microgyna group.

1. Head of the largest workers as broad as long (mandibles excluded) with the occipital margin strongly and evenly convex.....*morsei*
   Head of the largest workers longer than broad, or if as broad as long, the occipital margin is flat or slightly concave in the middle.....2
2. Femora and tibiae with erect or suberect hairs in addition to the double row on the flexor surfaces; antennal pilosity highly variable but often with erect hairs present.....3
   Femora and tibiae without erect hairs except for the double row on the flexor surfaces; antennal scapes always without erect hairs except for three or four at the extreme tip.....6
3. Dorsum of the gaster feebly shining over its entire surface; gastric pubescence very short and dilute and not concealing the surface sculpture.....*nepticula*
   Dorsum of the gaster opaque except for a feebly shining band at the edge of each segment; gastric pubescence long and dense and concealing the surface sculpture.....4
4. Hairs on the appendages golden brown and for the most part reclinate; gastric hairs short, yellow and widely separated; crest of the petiole with a few short hairs.....*knighti*
   Hairs on the appendages whitish or pale yellow, many of them fully erect, especially on the tibiae; gastric hairs whitish and close set; crest of the petiole with numerous fairly long hairs.....5
5. Erect hairs on the gaster very evenly spaced and all of about the same length; epinotum low with the angle between the two faces much rounded.....*impexa*
   Erect hairs on the gaster irregularly spaced and varying in length; epinotum high with the angle between the two faces only a little rounded.....*microgyna*
6. Occipital margin evenly convex in all sizes of worker.....7
   Occipital margin flat or slightly concave for at least half the width of the head in the largest workers and often in the small ones as well.....10
7. Front and vertex of the head with several, coarse, conspicuous, erect hairs present.....8
   Front and vertex of the head usually hairless, rarely one or two very short, fine, obscure, erect hairs present.....*indianensis*
8. Erect hairs present on the dorsum of the epinotum and the crest and sides of the petiole.....9
   Erect hairs absent on the dorsum of the epinotum and usually absent on the crest of the petiole.....*postoculata*

9. Erect hairs present on the occipital corners; front of the head slightly but distinctly more shining than the opaque thorax.....*difficilis*
Erect hairs absent on the occipital corners; front of the head fully as opaque as the thorax.....*querquetulana*
10. Erect hairs always present on the crest of the petiole; pubescence on the gastric dorsum dense and wholly concealing the surface; sides of the gaster feebly shining.....11
Erect hairs never present on the crest of the petiole; pubescence on the gastric dorsum rather dilute and not wholly concealing the surface at the rear edges of the segments; sides of the gaster strongly shining.....13
11. The majority of the erect hairs on the dorsum of the head and thorax notably spatulate and rather short.....*spatulata*
Erect hairs on the dorsum of the head and thorax, when present, blunt at the tip but not notably spatulate, except for a few on the pronotum..12
12. Erect hairs on the dorsum of the head and thorax sparse and inconspicuous, occasionally absent.....*rasilis*
Erect hairs on the dorsum of the head and thorax abundant and conspicuous.....*rasilis* subsp. *spicata*
13. Gula and genae subopaque, densely and evenly sculptured and without distinct punctures.....14
Gula and genae moderately shining with small punctures present in addition to the delicate surface sculpture.....*whymperi* subsp. *californica*
14. Promesonotum with at least a dozen short, erect hairs present.....15
Promesonotum with less than a dozen erect hairs present, often hairless *whymperi*
15. Head and thorax extensively infuscated.....*whymperi* subsp. *adamsi*
Head and thorax little or not at all infuscated...*whymperi* subsp. *alpina*

46. Formica densiventris Viereck

F. fusca var. *densiventris* Viereck, Trans. Amer. Ent. Soc., Vol. 29, p. 73 (1903) ♀.
F. fusca subsp. *densiventris* Brown, Ent. News, Vol. 58, p. 7 (1947) ♀.
Type loc: Beulah, New Mexico. Types: A.N.S.P.
Host: unknown.
Range: known only from New Mexico.

For many years the species which Viereck described as *densiventris* has been treated as a synonym of *subaenescens*. The redescription of *densiventris* which was recently published by Brown, clearly indicates that this old association was incorrect. At the same time, Brown's description makes it seem likely that the insect is a member of the *microgyna* group rather than the *fusca* group. In point of fact I feel fairly certain that *densiventris* is actually the same insect that Wheeler later described as *spicata*. If this surmise can be established as correct,

it will, of course, be necessary to replace Wheeler's name with *densiventris*. It is by no means certain, however, that this will be possible. Mr. Brown informs me that the two type specimens of *densiventris* are old and somewhat worn, hence it may never be possible to determine the exact affinities of *densiventris*. Under the circumstances, it seems best to shift this insect to the *microgyna* group but to make no attempt at keying it or associating it with *spicata* until its characteristics are better known.

47. Formica difficilis Emery

F. rufa subsp. *difficilis* Emery, Zool. Jahrb. Syst., Vol. 7, p. 651, pl. 22, figs. 9, 14 (1893) ☿ ♀ ♂.

F. difficilis Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 348 (1904); Wheeler, Bull. Mus. Comp. Zoöl Harvard, Vol. 53, No. 10, p. 477 (1913) (part).

F. difficilis var. *consocians* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 371 (1904) ☿ ♀ ♂.

F. habrogyna Cole, Amer. Mid. Naturalist, Vol. 22, No. 2, p. 413 (1939) ☿ ♀; Cole, Ann. Ent. Soc. Amer., Vol. 35, p. 389 (1943).

? *F. pallide-fulva* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 16, p. 889 (1866) ♀ (*nec* Latreille).

Type loc: Caldwell, New Jersey (by present restriction). Types: A.M.N.H., M.C.Z.

Range: southern New England to North Carolina and Tennessee and west to Iowa.

Host (temporary): *F.* (*Neoformica*) *incerta.*

It is most unfortunate that Wheeler was confused as to the exact nature of the typical *difficilis*. Wheeler had types of *difficilis* and presented a rather detailed description of this insect in 1913. According to Wheeler the typical *difficilis* possesses erect hairs on the gula but only 'very rarely' has them on the occipital angles. There is no doubt whatever that *difficilis* possesses gular hairs for Emery specifically mentions them in the original description of the insect. But to claim that *difficilis* lacks erect hairs on the occipital corners is wholly another matter. It is my belief that Wheeler arrived at this conclusion because he regarded as the typical *difficilis* the species which Kennedy and Dennis described as *querquetulana* in 1937. There can be no doubt on this point for most of the specimens identified by Wheeler as the typical *difficilis* are actually *querquetulana*. But there are no erect hairs on the gula or the occipital corners in *querquetulana*. The discrepancy between the specimens which he identified as *difficilis* and his description of that species seems never to have worried Wheeler. It is, however, the basis for his recognition of the variety

consocians. This insect has erect hairs on both gula and occipital corners and is, as Cole has shown, the typical *difficilis*. It is not surprising that subsequent investigators became confused over Wheeler's version of the typical *difficilis* for it may be doubted that any such insect as he described in 1913 exists. Cole, who became enmeshed in this tangle, redescribed *difficilis* as *habrogyna* but later rectified the error and pointed out the identity of *consocians*, *habrogyna* and *difficilis*.

48. Formica impexa Wheeler

F. impexa Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 273 (1905) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 472: (1913) ♀ ♀.
Type loc: Worker: Porcupine Mts., Michigan. Female: Sherborne, Massachusetts. Types: A.M.N.H., M.C.Z.
Range: New England west to Minnesota.
Host (temporary): *F. fusca*.

This species is very imperfectly known and is, apparently, subject to rather confusing variations in pilosity. Wheeler noted that the scapes of *impexa* are covered with erect, clavate hairs and that the erect hairs of the gaster are shorter than those of *microgyna*. No mention was made of hairs on the eyes. I have before me specimens from the nest taken by Morse at Sherborne, Mass. It may be recalled that the type females of *impexa* came from this colony. But the workers of the Sherborne colony have slender erect hairs on the scapes and delicate hairs on the eyes. Moreover, their gastric hairs are distinctly longer than is usually the case with *microgyna*. I am, however, not inclined to attach much significance to these variations for in one respect the pilosity of *impexa* is remarkably constant and characteristic. The erect hairs on the abdomen are all of about the same length and are very evenly spaced on the gastric surface. This fact will, in itself, give a very easy distinction between *impexa* and *microgyna*, for the latter species, which is the only one which would be likely to be confused with *impexa*, has gastric hairs which are irregular both in length and spacing.

49. Formica indianensis Cole

F. indianensis Cole, Amer. Mid. Naturalist, Vol. 23, No. 1, p. 224 (1940) ♀ ♂.
Type loc: Jasper County, Indiana. Types: Coll. A. C. Cole. Paratypes: Coll. W. S. Creighton.
Range: known only from type material.
Host: unknown.

The lack of erect hairs on the front and vertex of the head of *indianensis* distinguishes this species from *difficilis*, *querquetulana* and *postoculata*. It seems worth noting that the insect which Buren identified as *indianensis* (1944) is actually *postoculata*.

50. Formica knighti Buren

F. knighti Buren, Iowa State Coll. Jour. Sci., Vol. 18, No. 3, p. 303 (1944) ♀.
Type loc: Bonaparte, Iowa. Types: Coll. W. F. Buren. Paratypes: Coll. W. S. Creighton.
Range: known from type material only.
Host: unknown.

51. Formica microgyna Wheeler

Under the arrangement followed in this volume nothing is left of the large complex of variants which Wheeler placed with *microgyna* except *microgyna* itself. The writer has attempted to determine what specific characteristic Wheeler used that enabled him to include in *microgyna* the many dissimilar forms which he placed there. It most certainly was not hair pattern for, except in the case of *recidiva*, none of the other forms possess the erect hairs on the appendages which mark the typical *microgyna*. Indeed, one or two of them are remarkably hairless, *californica*, for example, being nearly as devoid of erect hairs as *integra*. The only feature which I have been able to discover which these insects share in common is the shape of the head of the major worker. In all cases the head of the largest worker is of a rather strongly rectangular type, with the sides not notably converging towards the mandibles and the occipital margin flat or slightly concave and breaking sharply into the occipital angles. There are, of course, minor variations on this pattern but, in general, the agreement is much better than in the case of other characters which Wheeler might have used as the means for recognizing the variants of *microgyna*. But if this supposition is correct, it runs afoul of a difficulty which Wheeler could not have anticipated when he assigned most of these variants to the *microgyna* complex. The head of *whymperi* is scarcely less rectangular than that of *microgyna*. As may be recalled, the status of *whymperi* remained enigmatical until 1917 at which time Wheeler was able to establish the relationship of Forel's species with the *microgyna* group. But while Wheeler realized that his own species *adamsi* must be transferred to *whymperi*, he failed to appreciate that certain forms which he assigned to *microgyna* show a far closer relationship with *whymperi*. He thus set up the indefensible situation

of having the limits of one species overlap those of a related species. There is no doubt that Wheeler knew that there was something wrong with this arrangement and it was probably this knowledge that led him to postulate in 1917 that the two insects might not be specifically distinct. As he had arranged the matter, they certainly were not distinct but the solution calls not for a fusing of *whymperi* with *microgyna* but rather for the proper treatment of those forms of *whymperi* which Wheeler assigned to *microgyna*. The distinguishing features of *whymperi*, in addition to its rather rectangular head, may be found in the character of the petiole and the abdominal pubescence. The scale of the petiole lacks hairs. It is high and in the large workers the crest often projects upward in a distinct median angular projection. The abdominal pubescence consists of a moderately dilute covering which thins out on the sides of the gaster and also over a band at the rear edge of each segment. This leaves the sides of the gaster rather strongly shining and in the bands at the edge of each segment there is visible a sculpture which consists of shagreening and many close-set punctures. If these features are taken into account, it is necessary to transfer to *whymperi* the variant *pullula*, which seems to be a straight synonym of that species, and the variants *californica* and *hybrida* both of which are representatives of a single southern race of *whymperi*. It is clear that the variants *rasilis*, *pinetorum* and *spicata* will not be affected by the above considerations. Each of these forms has erect hairs on the scale of the petiole and in each the gastric pubescence is more evenly distributed and somewhat denser. For this reason there are no partially exposed sculptured bands at the rear of the gastric segments and the sides of the gaster are only feebly shining. But if these three forms cannot be assigned to *whymperi*, neither can they be assigned to *microgyna* for they lack the erect hairs on the appendages which mark *microgyna*. Moreover, both *rasilis* and *spicata* occur in the same stations as *microgyna* without intergrading with it. It would for this reason alone be impossible to consider these forms as races of *microgyna*. I propose to treat *rasilis* as a separate species and to assign *spicata* to it as a subspecies. The form which Wheeler described as *pinetorum* appears to be a very inconsequential color phase of *spicata* and, while it might be defended as a geographical race of *rasilis*, it seems better to treat it as a synonym of *spicata*. There remain only the variants *recidiva*, *scitula* and *spatulata*. The first is clearly identical with *microgyna*. I believe that *scitula* should be regarded as a separate species and *spatulata* must certainly be so considered. As has already been noted, this leaves the species *microgyna* represented by only one form — the typical *microgyna* itself. There follows the synonymy of *F. microgyna* Wheeler:

F. microgyna Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 19, p. 645, fig. 3 (1903) ♀ ♀ ♂; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 465 (1913) ♀ ♀ ♂.

F. microgyna var. *recidiva* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 467 (1913) ♀ ♂.

Type loc: Manitou, Colorado. Types: A.M.N.H., M.C.Z.

Range: mountains of Colorado, Wyoming and eastern Utah at elevations up to 8500 feet.

Host (temporary): *F. fusca*, *F.* (*Proformica*) *neogagates*.

It is difficult to see why the variety *recidiva* was described. The scapes of *recidiva* were said to lack erect hairs and those on the tibiae were supposed to be more numerous than in the typical *microgyna*. The cotypes of *recidiva* which I have examined show neither feature and differ in no way from the types of *microgyna*. The specimens from which Wheeler described *recidiva* were taken at Florissant, Colorado, and at this same station Wheeler took many nests of the typical form. He recognized the existence of intermediates between the two. Since most nests of *microgyna* contain individuals which lack erect hairs on the antennal scapes, it would appear that Wheeler utilized such individuals as the type material for *recidiva*. It may have been that they were more than ordinarily numerous in the colonies which Wheeler took at Florissant but they certainly do not constitute all the type material of that form. Thus the definitive characters on which *recidiva* was founded will not apply to all of the type specimens of that variety. It is, of course, impossible to maintain the validity of *recidiva* for it cannot be regarded even as a nest variety.

The nests of *microgyna* are generally built in meadows or on open slopes. They are usually started under stones which are banked with thatching as the nest grows. Rarely a flattened mound of thatching is produced.

52. Formica morsei Wheeler

F. morsei Wheeler, Psyche, Vol. 13, p. 39, pl. 4, figs. a, b, c, (1906) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 480 (1913) ♀.

Type loc: Natick, Massachusetts. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: known only from type material.

Host: unknown.

It is to be hoped that additional data will be published on *morsei* for at present we know next to nothing about the species. There can be little doubt that Wheeler was correct in assigning *morsei* to the *microgyna* group but the final confirmation of this cannot be obtained until the sexual forms are discovered.

53. Formica nepticula Wheeler

F. nepticula Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 21, p. 270(1905) ♀ ♀ ♂; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 475 (1913) ♀ ♀ ♂.

Type loc: Colebrook, Connecticut. Types: A.M.N.H., M.C.Z.

Range: New England west to Iowa.

Host: unknown.

Buren has expressed the opinion that *nepticula* intergrades with *indianensis* (1944). There are several reasons why this view is unacceptable. As has been shown elsewhere Mr. Buren confused *indianensis* with *postoculata*. With this in mind we should have to assume that Mr. Buren's intergrades connect *nepticula* with *postoculata*, not with *indianensis*. Mr. Buren has very kindly supplied me with three of these intergrades and I have compared them with identical material in my collection from the Ramapo Mountains of southern New York. The specimens are comparable in every respect to those of *nepticula* except that they lack the delicate erect hairs on the sides of the femora and tibiae which supposedly characterize *nepticula*. I cannot see that there is any feature present that would justify an association with *postoculata* but it may as well be admitted that the absence of erect hairs on the legs poses a problem. Heretofore I had assumed that these less hairy specimens were individuals in which the delicate erect hairs had been rubbed away. This view was based on the fact that it is usually possible to find such individuals in any nest series of *nepticula* of good length. But if this difference runs through the entire nest series, as seems to have been the case with Mr. Buren's specimens, we will have to look for a better explanation. It may be that there are two races of *nepticula*, one with hairy legs and one in which the legs lack erect hairs. The mixed series might then be explained on the basis of intergradation between these two races. Unfortunately for this view, the typical hairy form seems to be present in the same stations with the mixed colonies. I cannot see, however, that there is any reason to regard the less hairy specimens as intergrades between species and, until we know more about this situation, they may be assigned to *nepticula* even though they fail to show the characteristic by which that species is most easily recognized.

54. Formica nevadensis Wheeler

F. microgyna var. *nevadensis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 373 (1904) ♀.

F. nevadensis Wheeler, Ibid., Vol. 21, p. 272 (1905); Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 470 (1913) ♀.

Type loc: Ormsby County, Nevada. Type: M.C.Z.
Range: known only from the type.
Host: unknown.

55. Formica postoculata Kennedy & Dennis

Formica postoculata Kennedy & Dennis, Ann. Ent. Soc. Amer., Vol. 30, p. 540, figs. 16–18 (1937) ♀.
Type loc: Aurora, Indiana. Types: Coll. C. H. Kennedy. Paratypes: Coll. W. S. Creighton.
Range: eastern Indiana to Iowa.
Host: unknown.

56. Formica querquetulana Kennedy & Dennis

F. querquetulana Kennedy & Dennis, Ann. Ent. Soc. Amer., Vol. 30, p. 536, figs. 10–15 (1937) ♀ ♀.
Type loc: Holland, Ohio. Types: Coll. C. H. Kennedy. Paratypes: Coll. W. S. Creighton.
Range: Ohio east to New England.
Host (temporary): *F. fusca.*

The color of *querquetulana* varies considerably. Specimens coming from the eastern seaboard are usually redder and less infuscated than those from Ohio.

57. Formica rasilis Wheeler

F. microgyna var. *rasilis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 19, p. 648 (1903) ♀ ♀ ♂.
F. microgyna subsp. *rasilis* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 468 (1913) ♀ ♀ ♂.
Type loc: Manitou, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: mountains of New Mexico, Colorado and Utah northwestward to Washington.
Host (temporary): *F. fusca.*

The Wessons have reported *rasilis* as occurring in Ohio (1940), but it seems clear from their own observations that the insect thus identified was actually *querquetulana.* All the distributional data point to the fact that *rasilis* does not occur east of the Rocky Mountain Region. The typical *rasilis* appears to nest at considerably lower elevations than its subspecies *spicata.* It is often found in foot-hill canyons and on the tops of low mesas and buttes which occur in such

areas. In the latitude of southern Colorado the elevational range appears to lie between 6000 and 7500 feet. There is a considerable overlap with the range of *spicata*, which descends to about 7000 feet and hence a great deal of intergradation between the two. I have one colony taken at Bryce Canyon, Utah, which shows all possible conditions of pilosity between *rasilis* and *spicata*.

58. Formica rasilis spicata Wheeler

F. microgyna subsp. *rasilis* var. *spicata* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 469 (1913) ♀ ♀ ♂.
F. microgyna subsp. *rasilis* var. *pinetorum* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 542 (1917) ♀.
Type loc: Florissant, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: mountains of Colorado and Utah west to the Sierras of California, usually at elevations between 7000 and 8500 feet.
Host: unknown.

In my opinion *pinetorum* is a synonym of *spicata*. The only difference in the two insects is the somewhat heavier infuscation of *pinetorum*. It seems worth noting that while Wheeler described *pinetorum* as more hairy than *spicata*, the types appear to average a little *less* hairy. There is so much minor variation in the erect hairs of *spicata*, however, that it is impossible to attach any significance to this difference.

59. Formica scitula Wheeler

F. microgyna subsp. *scitula* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 470 (1913) ♀.
Type loc: Clayton, Georgia. Type: M.C.Z.
Range: known only from the type.
Host: unknown.

The circumstances which attended the initial description of *scitula* make it a very problematical species and one could wish that its recognition had been delayed until adequate material had been secured. The species is known only from the single female type. This was taken at Clayton, Georgia, at an elevation said to be between 2000 and 3700 feet. The latter elevation seems more logical, for most of the southern records for the *microgyna* group come from considerable elevations in the mountains and Clayton is, I believe, the southernmost record for the group. Before any satisfactory treatment of *scitula* can

be made it will be necessary to know something about the worker caste. It would seem, however, that the insect ought to have specific status for it is clearly distinct from *microgyna*.

60. Formica spatulata Buren

F. microgyna subsp. *spatulata* Buren, Iowa State Coll. Jour. Sci., Vol. 18, No. 3, p. 305 (1944) ♀ ♀ ♂.

Type loc: Spirit Lake, Iowa. Types: Coll. W. F. Buren. Paratypes: U.S.N.M., Coll. Iowa State College, Coll. W. S. Creighton.

Range: Minnesota and Iowa west to Montana.

Host: *F. fusca*.

There are excellent reasons why *spatulata* should be given full specific status for in this species the female is more than usually distinct. The erect spatulate hairs of the worker of *spatulata* are not unique, for other species in the *microgyna* group possess such hairs, although none of them have such a high percentage of the hairs spatulate. For this reason there might be some doubt as to the specific status of *spatulata* were it not for the female. As Buren has noted, the thorax of the female of *spatulata* is proportionately more slender than that of *microgyna*. It also has a very different outline in profile being lower throughout, particularly in the posterior half, with the epinotum rather evenly rounded and showing scarcely any distinction between a basal and a declivious face. The surface of the head and thorax is finely and densely sculptured and opaque (feebly sculptured and somewhat shining in *microgyna*) and the erect hairs on head, thorax and gaster are notably spatulate (tapered and usually with pointed tips in *microgyna*). There are no erect hairs on the antennal scapes although there are a few erect clavate hairs on the femora. In my opinion the most obvious difference between the female of *spatulata* and that of *querquetulana* lies in the shape of the head. That of *spatulata* is shorter, both in actual length and in proportion to the width and has the occipital margin much more flattened in the middle (evenly convex in *querquetulana*). The sides of the head in front of the eyes are more compressed in *spatulata* so that the front half of the head is distinctly narrower than the rear half.

61. Formica whymperi Forel

F. rufa var. *whymperi* Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 152 (1904) ♀.

F. rufa subsp. *obscuripes* var. *whymperi* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 434 (1913) ♀.

F. whymperi Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 544 (1917).

F. microgyna subsp. *rasilis* var. *pullula* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 562 (1913) ♀ ♀.
Type loc: Vermillion Pass, British Columbia (5–6000 feet). Types: none in this country.
Range: British Columbia and Washington east to Montana.
Host (temporary): *F. pruinosa.*

Although Wheeler attached *pullula* to *microgyna*, it is a synonym of *whymperi*. Wheeler should have been aware of this for he commented on the remarkably angular petiole of *pullula* as a distinctive feature and later mentioned the same character as one of the peculiarities of *whymperi*. The upward projection in the middle of the petiolar crest is only one of the distinguishing features of *whymperi*. An even better one may be found in the cephalic structure of the female, which has a head with a very flat occiput and very well-marked occipital angles, with the sides converging evenly from the occipital angles to the insertions of the mandibles and not compressed in front of the eyes as is so often the case with the females of this group. In addition the surface sculpture is exceptionally dense, especially on the head, where it resembles very fine sandpaper. There is no way of telling whether the above features hold throughout all of the forms belonging to *whymperi* but it is my opinion that this will be found to be the case.

62. Formica whymperi adamsi Wheeler

F. adamsi Wheeler, Bull. Mich. Geol. Survey, Vol. 5, p. 326 (1909) ♀; Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 84 (1909) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 473, (1913) ♀.
F. whymperi var. *adamsi* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 544 (1917).
Type loc: Isle Royale, Michigan. Types: A.M.N.H., M.C.Z.
Range: Michigan to Minnesota.
Host: unknown.

It is interesting to note that there are two 'original' descriptions of *adamsi*. Both appeared in 1909 (see above) and in both *adamsi* was cited as a new species. Since the two descriptions are word for word the same it makes very little difference which is regarded as the original description.

63. Formica whymperi alpina Wheeler

F. adamsi var. *alpina* Wheeler, Bull. Mich. Geol. Survey, Vol. 5, p. 327 (1909) ♀; Wheeler, Jour. N. Y. Ent. Soc., Vol. 17, p. 84 (1909) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 475 (1913) ♀.

F. whymperi var. *alpina* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 544 (1917).
Type loc: Pikes Peak, Colorado. Types: M.C.Z.
Range: mountains of Colorado and Utah north to Idaho.
Host: unknown.

The subspecies *alpina* appears to furnish the only exception to the general rule that the scale of the petiole is hairless in *whymperi*. In most cases this is also true of *alpina* but one occasionally finds a nest in which some individuals will have one or two erect hairs on the crest of the petiole. It should also be noted that *alpina*, like *adamsi*, was described twice as a 'new variety'.

64. Formica whymperi californica Wheeler

F. microgyna subsp. *californica* Wheeler, Proc. Amer. Acad. Arts. Sci. Boston, Vol. 52, p. 543 (1917) ♀.
F. microgyna subsp. *californica* var. *hybrida* Wheeler, Proc. Amer. Acad. Arts. Sci., Vol. 52, No. 8, p. 543 (1917) ♀.
Type loc: Lake Tahoe, California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.
Range: California Sierras north to Washington and east to the mountains of Idaho and Montana.
Host: unknown.

The color of *californica* is very variable. Specimens coming from the northern parts of the range are usually much more deeply infuscated than are the types. The erect pilosity also varies to some extent and this is one of the reasons why I have made *hybrida* a synonym of *californica*. Most nest series show variations in pilosity which would cover both the typical form and *hybrida*. Wheeler was of the opinion that *hybrida* represents a cross between the typical *californica* and *pinetorum*. I have shown elsewhere that *pinetorum* must be regarded as a synonym of *spicata*. Even if this were not the case, I can see very little basis for Wheeler's view, for *hybrida* differs from the typical *californica* mainly in the presence of a few erect hairs on the head and thorax. The gastric pubescence of *hybrida* is not, in my opinion, intermediate at all but typically that of *californica*.

Species belonging to the *exsecta* group

It is much to be regretted that Wheeler's predilection for minor color variants led him to complicate the beautifully simple taxonomy of this little group of species. The species are unusually easy to handle

for, in addition to their other characteristics, each is marked by a constant and very distinctive pattern of erect hairs. But Wheeler's 1913 key is so constructed that these differences are subordinated to trifling distinctions of color and, what is worse, the two structural differences which Wheeler did employ are both incorrect. I am sorry to say that Wheeler's 1913 key is unusable if it is taken as written. His major split in the case of the North American forms is posited on the remarkable misstatement that the antennal scape of *exsectoides* is not thickened toward the tip. To anyone familiar with these species it is evident what Wheeler had in mind. The antennal scape of *exsectoides* is more gradually thickened toward the tip than that of *ulkei* or *opaciventris*. But since Wheeler repeated this odd error word for word in his description of *exsectoides*, it is not easy to see how anyone trying to make the acquaintance of *exsectoides* could possibly identify the insect from Wheeler's key.

In the present work I have accorded specific status to *opaciventris*. This species is fully as distinct as *ulkei* or *exsectoides* and, although it has long been considered a subspecies of the latter insect, it has little in common with it. As for the three varieties which Wheeler established in 1913, none can be defended, in my opinion. Both *davisi* and *hebescens* are founded upon color. Indeed, in the case of *davisi* the color distinction applies only to the female and Wheeler was unable to give any difference which would separate the worker of *davisi* from that of the typical *exsectoides*. The variety *hesperia* appears to be a straight synonym of *exsectoides*. I have discussed the confusing and peculiar discrepancies connected with this form on a subsequent page.

The habits of all three species in the *exsecta* group are remarkably uniform. The exemplar of this group is, of course, *exsectoides*, the much celebrated 'Mound Building Ant of the Alleghenies', whose habits have been repeatedly studied for three-quarters of a century. The first and probably the most famous of these studies was that of McCook, who in 1877 published a paper which contained an account of the 'ant city' of 1700 mounds near Hollidayburg, Pennsylvania. More recently Andrews has published many habit studies on *exsectoides* and his excellent account of the growth of these mounds (1925) is of particular interest. Andrews kept one mound under observation for nineteen years. His studies began when the nest was only three inches high and nine inches wide and continued until it had grown to a more or less conical mound with a maximum height of thirty-three inches, a maximum diameter of more than seven feet and an estimated content of almost thirty cubic feet. Andrews was able to show that the rate of growth varied considerably from year to year

but, in general, was slow at the start and accelerated as the mound increased in size. Andrews was also able to point out that during the first two years of construction a mound consists largely of excavated soil but later more and more surface soil and detritus enter into the construction.

It is generally assumed that where a large aggregation of mounds occur, a considerable proportion have been formed by the migration of a part of a colony from a previously established nest. *F. exsectoides* is notably pleometrotic and may have several dozen fertile females in one nest. This fact would favor migration for the loss of one or several of the females would in no way affect the well-being of the parent colony. But while there is very good reason to believe that such migration occurs, there is, as far as I have been able to determine, no published account of one. It is to be hoped that someone will have the good luck to observe the process and will publish on it for this sort of nest founding is a rather unusual one among ants. There is a large amount of evidence to indicate that when a female of *exsectoides* founds a nest after a nuptial flight she behaves as a temporary social parasite. Mixed colonies containing a female of *exsectoides* and workers of *F. fusca* have been found in Connecticut (Wheeler 2, Forel 1) Pennsylvania (Schmitt 5) and Virginia (Creighton 2). In addition, Wheeler has observed the behavior of the *exsectoides* female when introduced into captive colonies of *fusca* (1906, etc.). Since the female is very docile and conciliatory at such times and displays no pugnacity, it is thought that she probably seeks admission to a queenless colony of the host. On the other hand, it is possible that she manages to dispose of the rightful female in some fashion for, if it is supposed that the *exsectoides* female must always discover a queenless colony of the host before she can begin nest founding, her chances for survival would seem rather limited.

What has just been said for *exsectoides* will also apply in large part to *ulkei* and *opaciventris*. Wheeler was of the opinion that the nests of *ulkei* differ from those of *exsectoides*, but he had never encountered *ulkei* in the field and based his belief on observations made by Tothill in New Brunswick. It may be that at the eastern end of its range the nests of *ulkei* differ from those of *exsectoides* but this certainly is not true in the type locality of the insect. I have observed many nests of *ulkei* in the Black Hills of South Dakota and, while it may be admitted that none of them were as large as a really good-sized mound of *exsectoides*, they were extraordinarily similar to the average run of nests of that species. I have shown (1934) that *ulkei* is a temporary social parasite on *F. fusca*. The nests of *opaciventris* which I have seen at several stations in Colorado have always been built in rather harsh, gravelly soil and this may account for the fact that they are usually

less damp and spongy in texture than the nests of the other two species. I see no reason to suppose that *opaciventris* shows any special peculiarities in the matter of nest building. Its temporary host is not known.

Key to the species in the exsecta group

1. Dorsum of the promesonotum with at least two dozen conspicuous erect hairs; erect hairs of the lower edge of the pronotum and on the fore coxae long and numerous; erect hairs on the gaster present on all segments....2
   Dorsum of the promesonotum usually hairless, at most with one or two inconspicuous erect hairs; erect hairs sparse or absent on the lower edge of the pronotum and the fore coxae; erect hairs on the gaster confined to the terminal segments.....*exsectoides*
2. Front of head shining; crest of the petiole hairless; gaster moderately shining over the whole surface; posterior half of the head black or brown, thorax blotched with brown.....*ulkei*
   Front of head opaque; crest of the petiole with several short erect hairs; gaster in large part opaque; head and thorax ferrugineous red..*opaciventris*

65. Formica exsectoides Forel

F. integra Mayr, Verh. Zoöl-bot. Ges. Wien, Vol. 12, p. 70 (1862) ♀; Mayr, Ibid.Vol. 36, p. 425 (1886) ♀ ♂ (*nec* Nylander).

F. rufa McCook, Trans. Amer. Ent. Soc., Vol. 6, p. 295 (1877) ♀ ♀ ♂ (*nec* Linné).

F. exsectoides Forel, Ann. Soc. Ent. Belg., Vol. 30, C.R., p. 38 (1886) ♀ ♀; Emery, Zool. Jahrb. Syst., Vol. 7, p. 653, pl. 22, fig. 6 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 481 (1913) ♀ ♀ ♂.

F. exsectoides var. *davisi* Wheeler, Ibid. p. 484 (1913) ♀.

F. exsectoides var. *hesperia* Wheeler, Ibid. p. 484 (1913) ♀.

Type loc: New Hampshire. Types: none in this country.

Range: Nova Scotia south to Georgia and west to Wisconsin and Iowa. Even at the latitude of New York the insect is more abundant in the hills than at sea level and from Virginia southward it is entirely confined to the mountains, where it occurs at elevations between 3000 and 4000 feet.

Host (temporary): *F. fusca.*

I have discussed the reason for treating the variety *davisi* as a synonym in a previous paragraph. It is necessary to consider the case of the variety *hesperia* in more detail. The description of this variety is so consistently inaccurate that it may be wondered if Wheeler ever made any serious attempt to study the types from which he described it. It may be recalled that *hesperia* was described from twenty-eight workers, said to have been taken at Colorado Springs, Colorado. The length of these specimens varies from 4.5–6 mm. They are, therefore, smaller workers or minors. The significance of this fact will be pres-

ently shown. According to Wheeler the distinguishing feature of *hesperia* is its petiolar scale which is narrower, lower and thicker than that of the typical *exsectoides*. Seen from behind, the crest of the scale is said to be truncate and its shape like that of *dakotensis*. Unfortunately, none of these distinctions will apply to the types of *hesperia* if one compares them with the workers of *exsectoides* which have the same size. I believe that Wheeler must have compared them with full-sized workers of *exsectoides* for, if one makes such a comparison, some of the features which Wheeler described can be noted. But it is obvious that a separation based on this sort of comparison is entirely unjustified. Before leaving this matter I wish to correct two extremely misleading points in Wheeler's description of *hesperia*. The crest of the petiole is *not* truncate and when seen from behind it's outline is *not* like that of *dakotensis*. The crest of the petiole is feebly convex and the sides slope inward from the crest to the peduncle, as is usually the case in the smaller workers of *exsectoides*. The one peculiarity of *hesperia* is the station from which it came. This is so far to the west of the range of *exsectoides* that it is no wonder that Wheeler was ready to regard *hesperia* as something new on the basis of distribution alone. But there are several considerations which make this record strongly suspect. In the first place, Wheeler claimed to have taken the nest under a stone, an unusual situation for a nest of *exsectoides*. But one may suppose that the colony was an incipient one, a fact which is favored by the small size of the members of the type series. If so, why was not the host species present? Finally, and this is the most telling point of all, why has not the insect been rediscovered in the vicinity of Colorado Springs? It is exceedingly unlikely that if *exsectoides* were present in that area it would have escaped further observation, for it cannot be claimed that the nests of *exsectoides* are inconspicuous and wherever it occurs it invariably attracts attention, both because of its distinctive nests and also because of its extreme pugnacity. It is my opinion that the types of *hesperia* are actually specimens of the eastern *exsectoides* which in some way became mislabelled. It is also my opinion that this circumstance contributed largely to the difficulties with which Wheeler became involved in the case of *hesperia*. Since he believed it to be a western race of *exsectoides*, he was led to enumerate differences which do not exist.

66. Formica opaciventris Emery

F. exsectoides var. *opaciventris* Emery, Zool. Jahrb. Syst., Vol. 7, p. 653 (1893) ♀ ♂.

F. exsectoides subsp. *opaciventris* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 484 (1913) ♀ ♂.

Type loc: Breckenridge, Colorado. Types: A.M.N.H., M.C.Z.
Range: mountains of Colorado and Wyoming. The range of *opaciventris* appears to be confined to high intermountain valleys. It does not occur on the eastern slopes of the Rockies.
Host: unknown.

67. Formica ulkei Emery

F. ulkei Emery, Zool. Jahrb. Syst., Vol. 7, p. 653, pl. 22, fig. 7 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 485 (1913) ♀ ♀ ♂.
F. ulkei var. *hebescens* Wheeler, Ibid. p. 487 (1913) ♀.
Type loc: Worker: Hill City, South Dakota. Female: Ship Harbor, Nova Scotia. Types: M.C.Z. (gynetype only).
Range: Nova Scotia westward to Manitoba, Montana and South Dakota. The insect does not range south into New England but reaches northern Indiana, Illinois and Iowa.
Host (temporary): *F. fusca.*

The insect which Wheeler described as the variety *hebescens* is a very minor color phase which occurs over the eastern portion of the range of *ulkei*. It is not possible to regard *hebescens* as a geographical race for, with the exception of the type series, it has always been taken in areas where the typical *ulkei* also occurs.

Species belonging to the *fusca* group

The taxonomic position of the *fusca* group has been discussed in the introductory paragraphs dealing with the subgenera of Formica. There is no need to repeat this discussion here but it its necessary to consider the taxonomic problems presented by *F. cinerea* and *F. fusca*. A large number of infraspecific forms have been assigned to each of these species and the status of many of these forms, particularly in the case of *fusca*, is unsatisfactory. The revisionary changes which have been made to rectify these difficulties are unusually extensive. I regret that it is necessary to review the taxonomy of each of these species in detail. Without this, however, the reasons for many of the revisionary changes cannot be made clear. It has seemed better to present a single account for each of the above species for, if the revisionary changes are dealt with under each of the forms involved, a great deal of repetition results. We shall deal first with *F. cinerea*.

Most of the forms previously considered variants of *cinerea* have, in this work, been treated as separate species. In a sense, this represents a return to the stand which Emery advocated more than half a

century ago. As early as 1893 Emery had described two North American members of the *cinerea* complex. These were *pilicornis* and *montana*. Emery was aware that these two insects were related to *cinerea*, but he chose to regard each of them as a separate species and denied that the true *cinerea* occurred in North America. This view was soon to be questioned. In 1902 Wheeler, who had interested himself in the *cinerea* problem, announced that specimens in all respects similar to the European *cinerea* occurred in Illinois and California. At first Wheeler was inclined to treat these specimens as identical with the European *cinerea* but by 1910 he made a distinction in the case of the material coming from the eastern United States. He gave to these specimens the varietal name *neocinerea*. Oddly enough this was done without any accompanying description. The name *neocinerea* appeared for the first time in the check list of North American ants which was published in Wheeler's volume *Ants*. It was not until three years later that he published the description of this variety. This was carried in his 1913 monograph of the genus Formica. The original descriptions of the varieties *rutilans*, *altipetens* and *lepida* also appeared in this monograph. All these varieties were assigned to *cinerea* as was *pilicornis*, which Wheeler treated as a subspecies of *cinerea*. In addition, Wheeler observed that *montana* and *rutilans* are closely related and that perhaps *montana* ought also to be regarded as a variety of *cinerea*. It may be seen that Wheeler was attempting to treat *cinerea* exactly as he treated *fusca* by giving all the forms in the complex varietal rank. It is not surprising that this should have been the case, for with both species Wheeler insisted in placing much stress on color and minor details of sculpture and pilosity as significant separatory characters. That he found intergrading conditions in the case of such characters is no more than natural but it seems clear that Wheeler's preoccupation with minor color differences obscured his view of other differences of a much sounder sort. For Wheeler seems to have been singularly unfortunate in his use of major structural features in the case of *cinerea*. He attempted to distinguish between individuals having a broad petiolar scale with a notched crest (*altipetens*) and those having a narrow petiolar scale with the crest blunt and entire (*neocinerea* etc.). This distinction is of very little value for the differences which Wheeler used are present in every series of workers in which the size varies. The character used to distinguish *altipetens* is shown by most large workers, that used for *neocinerea* is shown by most small ones. In this connection it is of interest to note that the type series of both *altipetens* and *neocinerea* contain individuals which, according to Wheeler's diagnostics, could not be considered as belonging to the respective species. This is not to say that the two

insects cannot be separated but what must be admitted is that a considerable part of Wheeler's 1913 key to the *cinerea* forms is virtually worthless.

After studying a large amount of material belonging to the *cinerea* complex and observing three of the four forms in the field, the writer has reached the conclusion that there are four distinct species involved. These species and their synonyms are as follows:

F. altipetens Wheeler
F. cinerea subsp. *lepida* Wheeler
F. montana Emery
= var. *neocinerea* Wheeler
= var. *rutilans* Wheeler
F. pilicornis Emery

The exact status of the insect which Santschi described as *cinerea* var. *canadensis* in 1913 cannot be determined without reference to the types but it seems very likely that it is either *altipetens* or *lepida* for both of these species throw dark forms whose color corresponds closely with that described for *canadensis* by Santschi.

In presenting the reasons on which the above arrangement is based, we may first dispose of *pilicornis*. It is quite impossible to consider this insect as a subspecies, since it does not show the slightest tendency to intergrade with other forms present in California. Moreover, it possesses a number of unique structural features any one of which would be enough to give it specific status. In addition to its extraordinarily abundant pilosity, *pilicornis* possesses a clypeus in which the middle of the anterior border is very broadly truncate. The upper surface of the head bears a number of prominent punctures which clearly show through the dense grey pubescence which covers the surface. The occipital angles of *pilicornis* are not strongly rounded, the occiput is not evenly convex and the head does not narrow towards the mandibles as much as is the case with the other members of the *cinerea* complex. One could scarcely ask for a greater number of distinctive features than are shown by *pilicornis* and there is no reason whatever to deny this insect the specific status which it so clearly merits.

It would be gratifying if the same clarity marked all the species in the *cinerea* complex. This is not the case for the differences which mark them are slight. Nevertheless they seem to be reliable. Thus *montana* and its two synonyms, *rutilans* and *neocinerea*, all possess a distinctly elevated mesonotum in which the anterior edge stands well above the adjacent edge of the pronotum and forms a small angle with

it. In addition, there are usually numerous erect hairs present on the occipital angles, although these do not extend forward onto the cheeks. The thoracic structure of *montana* differs from that of *altipetens* and *lepida*, for in both the latter species there is, at most, very little elevation to the mesonotum and the majority of the specimens show an evenly convex promesonotum in which the only break is formed by a very shallow and often obsolete impression at the promesonotal suture. The pilosity of these species is different from that of *montana* but, as this difference constitutes the main means for separating *altipetens* and *lepida*, it can be discussed as such. I am sorry to say that I have been unable to discover any difference other than that of pilosity pattern by which these two forms may be separated. It may be recalled that Wheeler utilized this same characteristic, and all that is necessary here is to revise his statement to conform with the much more abundant material which is now known for these two insects. In *altipetens* the cheeks lack erect hairs and so do the occipital angles as a general rule. In certain specimens, however, there may be a few sparse erect hairs on the occipital angles. Erect hairs on the pleurae appear to be very rare in *altipetens* but I believe that Wheeler was mistaken in supposing that they are also absent on the flexor surfaces of the legs. On the contrary, there are usually a few such hairs present. In *lepida* there are erect hairs on the cheeks and also on the occipital angles. In addition, although the type series of *lepida* appears to have lacked them, there are usually erect hairs on the pleurae and, of course, on the flexor surfaces of the legs. In this connection it seems worth noting that Wheeler made a rather serious *lapsus calami* in his description of *lepida*. He obviously meant to state that erect hairs were present on the flexor surfaces of the legs, for he had used this characteristic in the key. Instead he stated that erect hairs are present on the *extensor* surfaces of the legs. Except for *pilicornis*, there is no member of the *cinerea* complex which has erect hairs on the extensor surfaces of the legs. Although the differences in the hair pattern which distinguish *altipetens* and *lepida* are not great, I believe that they have more significance than might appear at first sight. Since the typical *cinerea* of Europe possesses erect hairs on the pleurae and the cheeks, it follows that in this respect *lepida* approximates the typical form more closely than any of our representatives of the *cinerea* complex. For this reason, I have retained it as a subspecies of *cinerea* although it is not unlikely that future studies will show that *lepida* also deserves specific status. We may thus finally return to Emery's original stand that there are no representatives of *cinerea* present in North America.

One further point should be noted in connection with *altipetens* and *lepida*. Wheeler was unaware that both species exhibit a broad

tolerance for elevation and that both vary considerably in color. The range of *lepida* is blanketed by the more extensive range of *altipetens*, hence the two species occur together over a region which begins a little east of the Rocky Mountains and extends to the Pacific Coast. In the eastern part of the range, most of the specimens are dark but as one goes westward, the color lightens until, on the Pacific coast, both species are represented by individuals in which the thorax is reddish yellow and only the head and gaster are brown or brownish black. Since this was the color of the type series of *lepida*, Wheeler assigned to that form, or to *neocinerea*, all the light colored specimens coming from the Pacific Coast. By so doing he gave to *montana* (or, as he called it, *neocinerea*) a much greater range than it actually possesses. At the same time he took away from *altipetens* its western representatives. It is my opinion that the range of *montana* does not extend west of the Rockies and I have collected a large amount of material which shows that both *altipetens* and *lepida* occur in abundance in the region extending from the Rockies to the Pacific Coast. It is possible that we may subsequently be able to recognize eastern and western races for each species on the basis of the color differences just mentioned. In this connection, it is interesting to note that specimens of *lepida*, which I took in the Lost River Range east of Dickey, Idaho, have the intermediate color which might be expected under such circumstances. But it will not be an easy matter to evaluate this color difference for both species seems to be affected by elevation. Specimens coming from high altitudes are nearly always darker than those taken at lower levels.

We shall now consider the problem presented by *F. fusca*. Here, as in *cinerea*, the major difficulty lies in the fact that the species has been overloaded with infraspecific variants. Much of this difficulty is the unavoidable outcome of work done by early European myrmecologists. Since *fusca* is both abundant and variable in Europe, the earlier workers had created many synonyms and had neglected obvious relationships. Mayr, Emery and Forel thus received a singularly difficult heritage in the case of this species and to rectify the matter drastic steps were necessary. It is not surprising that in the extensive revisionary work which followed, some of the proposals erred on the side of conservatism. During the last part of the nineteenth century there grew up around *fusca* a welter of closely related forms which were usually treated as varieties although many of them had been originally described as separate species. It was not long until it became apparent that the revisionary pendulum had swung too far. There was, particularly on Emery's part, a recognition of the incongruity in treating all these variants as nothing more than varieties.

It seems likely that Emery's view would have led to the breakdown of *fusca* into a number of species had it not been for Wheeler's insistence that the forms can only be treated as varieties. From this stand Wheeler departed only once, when he described the subspecies *pruinosa* in 1917. It can be shown that Wheeler's view is not consistent with the character of many of the variants which have been assigned to *fusca* and it is possible to suggest why he was led to this untenable position. The features which Wheeler used to distinguish the *fusca* variants were, to a surprising extent, slight differences in color and minor details of pilosity. Both these features are highly variable in the group of forms involved. That Wheeler found such criteria inconstant and unreliable is not surprising. But this does not prove that the members of the complex all lack good separatory characters and, if Wheeler had not been so preoccupied with color and pubescence, he might have seen that several members of the *fusca* complex possess distinctive structural features that clearly entitle them to specific status. But as he examined more and more material in the group, Wheeler became increasingly involved in a hopeless attempt to distinguish between *fusca*, *subsericea*, *argentea* and *subaenescens* and the futility of his attempts to secure any satisfactory separation between these forms is, I am convinced, the real basis for his view on the remainder of the group.

It seems to me that the only possible hope for dealing successfully with the American representatives of the *fusca* complex lies in recognizing the fact that all the variants cannot be relegated to the same taxonomic category. As soon as one realizes that this assemblage contains species, subspecies and a number of named variants which are too unstable to warrant recognition, the major part of the difficulty has been overcome. For one can then accord to these forms, the treatment which their structural and distributional characteristics demand and one is freed from the necessity of trying to force them into a uniformity which they clearly do not possess. If such considerations are taken into account, the American representatives of the *fusca* complex can be assigned to five species and two subspecies, all of which behave in a perfectly normal manner. That is to say that the species will coëxist with other species without intergradation and the subspecies will occupy separate ranges and intergrade only in those areas where the ranges come in contact. There remains, of course, a residuum of forms which will do neither. These are the endlessly intergrading phases of *fusca* and for them there appears to be only one solution — synonymization. According to the above plan the *fusca* complex breaks down as follows:

F. fusca Linné
= var. *glacialis* Wheeler
= var. *subsericea* Say
= var. *argentea* Wheeler
= var. *subaenescens* Emery
= *F. lecontei* Kennedy and Dennis
F. marcida Wheeler
F. neoclara Emery
= var. *lutescens* Wheeler
F. neorufibarbis Emery
" subsp. *gelida* Wheeler
" subsp. *algida* Wheeler
F. pruinosa Wheeler

Wheeler's variety *blanda* does not appear in the above list. The reasons for its exclusion are given on a subsequent page.

There is nothing in the above arrangement that is abstruse or difficult to explain. As has already been noted, it is based on the proposition that it is possible to distinguish between characters which are reasonably constant and those which are wholly inconstant and hence unsatisfactory for purposes of taxonomic separation. By this I do not mean to imply that the characters used as the basis for specific recognition in the above list are absolutely rigid and show no tendency whatever to vary. No one, who has dealt extensively with the *fusca* complex, would be likely to subscribe to any such statement. But there is sufficient constancy in the characters employed to permit the recognition of the occasional exception as exceptional. This is an entirely different situation from the endless permutation and combination of minor differences of pubescence, sculpture and color which are present in *fusca*. There it is impossible to distinguish between what is the rule and what is exceptional because there is no rule. Despite the fact that there has been much effort expended in attempts to sort out and name segments of this fluctuating population, these attempts have invariably been unsuccessful because the population forms a completely intergrading whole. Its subdivision is, for this reason, not dependent upon the recognition of natural groups but wholly a matter of where the investigator elects to set the boundaries of the several named variants.

I am not so sanguine as to expect that the arrangement proposed above will be accepted without factual substantiation. I do not anticipate any strenuous objection to the recognition of the four new species for it would seem that we have been tacitly treating them as such under varietal names. Moreover, in the case of these species, I

have been able to utilize positive distinctions (which have been used as the basis for keying) and these can be tested and will, I believe, be found satisfactory. On the other hand, there is certain to be objection to the synonymization of such time-honored varieties as *subsericea* and *subaenescens*. These two names have now been in use for more than half a century and the burden of the proof will lie with the person who proposes to abolish them. In addition, the synonymy proposed is of a peculiar sort for, except in the case of *lecontei* which is identical with the insect that Wheeler regarded as *subsericea*, it does not involve identical forms. What I shall attempt to show in the ensuing paragraphs is not that *subsericea* and *subaenescens* and *argentea* are identical with the typical *fusca* but rather that, if enough material is examined, there is no possibility of maintaining the individuality of these variants. In each case their recognition was the result of an incomplete knowledge of *fusca* and in each case their existence can only be maintained by the use of arbitrary and artificial distinctions which are, in my opinion, quite unjustified. To prove this point, involves a complicated and tedious discussion which I have undertaken here only because there seems to be no other way of showing what these variants actually are.

The first step in the problem was taken in 1893. In that year Emery revived Say's 'lost' species *subsericea* and made it a variety of *fusca*. At the same time Emery described a second variety, *subaenescens*. The difference which separated the two was largely a matter of the amount of pubescence on the gaster; it was abundant in *subsericea;* it was sparse and dilute in *subaenescens*. It may be added that, except for the name itself, Emery made no reference to a coppery or bronzy surface as a distinctive character of *subaenescens*. It is difficult to say how much material of *subsericea* Emery possessed for he refers to specimens from the east and central states. But it is clear that in *subaenescens* Emery had very limited material, for he specifically stated that he had seen only workers from South Dakota and Connecticut. It might, therefore, have been expected that Emery would have had a sharp and satisfactory separation between the two forms. Actually, he noted that he had several specimens from New Jersey which were intermediate in character between the two. If more attention had been paid to this last observation and less to the effort to force the two forms apart, much subsequent difficulty might have been saved.

In 1902 Wheeler embarked upon his studies of the *fusca* complex with the description of a variety which he called *argentata*. This was a preoccupied name which he later changed to *argentea*. The type material of *argentea* was taken at Rockford, Illinois, and came from two

nests which were discovered in an area containing many nests of the typical *subsericea*. The original description of *argentea* was as follows:

"The ants from these nests are smaller and more graceful in stature than the common *subsericea*, the legs and antennae are red like those of *cinerea* and the body is so thickly overlaid with silvery white, appressed pubescence that the black ground color is hardly visible."

Six years later Wheeler described another *fusca* variant. This was the variety *glacialis*. The types of *glacialis* were taken in South Harpswell, Casco Bay, Maine, and both *subsericea* and *argentea* were present in the type locality. Wheeler was, however, in somewhat better case in the matter of records for *glacialis*, for, in addition to the type material, he had specimens coming from seven stations ranging from New York to Newfoundland. The original description of the worker of *glacialis* is as follows:

"The worker of this form averages smaller than those of the vars. *subsericea* and *argentata* (5–6 mm.) and is deep black with only the mandibles, scapes, base of the funiculus, knees, trochanters and tarsi reddish. The pubescence of the body is decidedly shorter and more dilute so that the surface appears smoother and more shining but less so than in the variety *subaenescens* Emery."

On the basis of the above descriptions, one would suppose that the four forms represent a graded series as far as pubescence is concerned with *argentea* the most pubescent, then *subsericea*, next *glacialis* and finally *subaenescens* with the least pubescence of all. In addition, it might be supposed that *argentea* and *glacialis* are significantly smaller than *subsericea* and*s ubaenescens*. I think there can be no doubt that Wheeler at first regarded the variants in this fashion, but by the time that he published his monograph on Formica in 1913 some disconcerting changes had come into the picture. Wheeler had by this time examined considerable material belonging to this group of variants and had reached the conclusion that his variety *glacialis* was a synonym of the typical European *fusca*. It is significant to note the number of records which Wheeler published for each of the four variants in 1913. Wheeler recorded *fusca* (= var. *glacialis*) from forty stations, *subaenescens* from thirty-eight stations, *argentea* from forty-one stations and *subsericea* from eighty-one stations. One cannot claim that he lacked the material for purposes of comparison but it may be submitted that, because of this very fact, some curious modifications began to appear in Wheeler's characterization of the four variants. The size of *fusca* (= *glacialis*) had increased to 6.5 mm. It was no longer marked by a dilute pubescence but instead by a comparatively dense one. This feature was twice repeated, once in the key where *fusca* was brought out on a lug in which the gaster was described as

"opaque or subopaque, densely pubescent" and again in the description of *fusca,* the pertinent part of which is as follows:

"Pubescence dense on the head, thorax and gaster, longest on the gaster giving the surface a slightly pruinose but not a silky appearance."

Finally, at the end of his description of *fusca* Wheeler noted that the pubescence of many of the western specimens is "often a little more like *subsericea.*"

At the same time the other variants were undergoing similar changes. The variety *argentea* had become fully as large as *subsericea* (4–7 mm.) and the original sharp distinction in the color of the antennae and legs was whittled down to the difference between brown to dull red appendages (*subsericea*) and light red to yellowish ones (*argentea*). The change in the case of *subaenescens* was even more startling. Although Wheeler keyed out *subaenescens* with the forms having a shining and sparsely pubescent gaster, his description of *subaenescens* and the note which appeared at its end show that Wheeler had given up pubescence as a definitive characteristic for *subaenescens* and had substituted for it the presence of a coppery ground surface. For on this basis, Wheeler assigned to *subaenescens* specimens whose pubescence would otherwise have placed them with *subsericea* or *fusca.* But since Wheeler had noted that *subsericea* "often has a faint metallic luster" it follows that this character was no more certain than the others.

In my opinion, there is only one explanation for the change which marked Wheeler's 1913 treatment of these four variants. As Wheeler examined more and more material of these variants, the original distinctions on which they had been based began to break down. With every added effort to make the variants more certainly recognizable, Wheeler was demonstrating the impossibility of securing satisfactory distinctions between them. But instead of admitting that the *fusca* population forms a fluctuating but indivisible whole, Wheeler attempted to bolster the failing structural criteria with some extraordinary observations on the distribution of these forms. With the typical *fusca,* Wheeler could do little because of its ubiquity but in the case of *argentea* he made the following statement:

"It evidently belongs to the colder portions of the Transition Zone and is common in the mountains in the western part of the country between elevations of 7000 and 11,000 ft., but more sporadic in the Eastern States."

I have no wish to become involved in a discussion of zonation here but I submit that an insect, which is common between elevations of 7000 to 11,000 feet, cannot be considered as belonging to the colder portions of the Transition Zone no matter what the latitude may be.

Indeed Wheeler repeatedly disproved his own statement by citing other species as 'alpine' (*altipetens, alticola* etc.) when the latter occurred in the same latitudes and at considerably lower elevations than 11,000 feet. All that Wheeler's statement on the distribution of *argentea* can be taken to show is that the form is more abundant in the western states and that it occurs in mountainous regions at both high and moderate elevations. In other words, its distribution does not differ significantly from that of the typical *fusca*. The situation is even more aggravating in the case of *subaenescens* which Wheeler attempted to convert into a boreal or alpine form. According to Wheeler, *subaenescens* is 'rare and sporadic at lower elevations and latitudes in the Transition Zone'. Yet if one examines the thirty-eight records for *subaenescens* carried in Wheeler's 1913 monograph, more than half of them are from stations which cannot under any circumstances be considered as boreal or alpine. What has just been said about the distribution of *argentea* may be repeated for *subaenescens*. There is nothing in the distribution of *subaenescens* to indicate a significant difference between it and the typical *fusca*. It is curious that in 1913 Wheeler made no attempt to recognize *subsericea* as an eastern form, although seventy-eight of the eighty-one published records were from eastern stations. It was not until 1917 that Wheeler expressed doubts that *subsericea* occurs in the western states and it must be admitted that the published records certainly favor such an interpretation. The situation is, however, by no means as simple as might appear. I have already shown that by 1913 Wheeler was having trouble with pubescence as a separatory character for these variants. He was, wherever he could do so, substituting other separatory characters. Thus he was no longer distinguishing between *subsericea* and *argentea* on the basis of the denser and more silvery pubescence of the latter form but on the basis of the color of their appendages. It happens that the great majority of the pubescent western specimens have red or yellow appendages. If, therefore, one insists upon brown appendages as the hall-mark of *subsericea*, it follows that most of the western specimens will be assigned to *argentea*. But it does not follow that these western specimens with red or yellow appendages will all have the dense, silvery pubescence supposedly characteristic of *argentea*. In point of fact comparatively few of them do. I have convinced myself of this by the examination of a great deal of material which I have collected in the west and also by examining the material present in the Wheeler Collection. Fully half of this material has a pubescence like that of *subsericea* and can be distinguished from that form only because of the slightly lighter color of the appendages. It can be argued that about half the records for *argentea* coming from the

western states might with equal propriety be transferred to *subsericea*. It can also be argued that Wheeler's attempt to make *subsericea* into an eastern race is an outcome of the fact that only in the east could he distinguish between that variant and *argentea*. There is no denying that *subsericea* is distinctly more abundant in the east than are the other forms but I do not believe that it can be correctly claimed that it is limited to that area. Forms having the characteristics of *subsericea* are produced over the entire range of *fusca* and it is only in the east that they exist in comparatively pure stands without great admixture with the other variants. But this distributional peculiarity, while interesting, will not permit the recognition of *subsericea* as a geographical race for, while it is more abundant in the east than the other forms, these forms are also present. There is, in my opinion, no reason to suppose that any one of the three *fusca* variants behave as geographical races. On the contrary, all the evidence tends to show that they are produced at random over the entire range of *fusca* and that it is only occasionally that one finds an area in which all the variants are not present.

I wish, before concluding this discussion, to take up the possibility that these forms might be ecologically separable. It would be extremely desirable to show that the structural features of these variants can be correlated with a distinctive type of nest construction or a preference for some particular habitat. For one could then be certain of their identification in the field if not as cabinet specimens. Unfortunately, there appears to be very little likelihood of arriving at any ecological distinctions which will consistently separate the variants. Like the typical *fusca*, all the variants are highly adaptable and will utilize a great variety of nest sites and construct several types of nests. It is, of course, impossible to cite in detail the large number of reports which have now been published on the nesting habits of these variants. But to summarize these, one may say that all four forms have been taken from mound nests, from bed nests, from nests under logs or stones, from nests constructed along the seashore, from nests in open deciduous woods, from nests in heavy coniferous woods, from dry meadows and open prairies, from canyons and plateaus in the west and from alpine meadows. If any ecological distinction occurs, it is only in the case of local populations and such differences are not applicable on a broad scale. Thus to the breakdown of structural criteria and the failure of distributional distinctions must be added the lack of any ecological difference by which these variants may be separated.

It seems clear that Wheeler was ultimately aware of this situation. There is no other conclusion to be drawn from the following statement which he published in 1917:

"In my revision I have given a long list of localities of this species (*fusca*) which is the most eurythermal and therefore the most widely distributed of all the species of Formica in North America as well as in Eurasia. In the Western States it varies considerably in size and pubescence and in the coloration of the legs and antennae, but I deem it inexpedient to give these varieties names at the present time. Many of them seem to represent transitions between the typical form and the following four varieties." (*subsericea, marcida, argentea* and *subaenescens*)

It is a matter for commendation that most American myrmecologists have been extremely circumspect in regard to the variants of *fusca*. Except for the description of *lecontei* by Kennedy and Dennis, there has been no attempt to add any new names to this complex. But it seems to me that Wheeler's negative attitude must be replaced by a positive one if we are to have any relief from the difficulties of *F. fusca*. It is not enough to refrain from naming new variants. We must also arrive at an acceptable method for handling those which have already been named. In my opinion, the case against *argentea, lecontei, subaenescens* and *subsericea* is one of exceptional clarity. Not only has it been impossible to supply satisfactory criteria for the separation of these forms but every effort in this direction has weakened their status instead of improving it. I can see no reason for applying names to forms which cannot be distinguished by any constant structural, distributional or ecological difference. For, in the last analysis, the recognition of the above variants depends upon a lack of knowledge for its success. It is only when one is dealing with a small segment of the *fusca* population that distinctions between variants can be drawn. They invariably weaken and disappear when extensive material is examined. Perhaps additional studies will bring to light differences which are not at present apparent. But until these are forthcoming the only possible treatment for the four forms mentioned above is synonymization.

Despite the lengthy taxonomic prelude just presented, it seems advisable to include a brief summary of the habits of the species in the *fusca* group. If left to themselves, the members of this group rarely show any spectacular habits but they have interesting reactions thrust upon them through the activities of the slave-making species. Most of the species in the *fusca* group are singularly lacking in pugnacity. The only really aggressive form is *F. rufibarbis occidua*, although *F. rufibarbis gnava* and *F. montana* will usually make some attempt at defending their nests. But the other species seem very little inclined to do so, with the result that they are usually regarded as cowardly or timid insects. Perhaps their reactions are more the result of docility

than cowardice, for those individuals which have been brought into the nests of slave-making species acquire all the pugnacity of their captors, a highly interesting fact for which there has not yet been any good explanation.

The docility or timidity of these species is only one of the factors which make them ideal subjects for slave-making. The other is their ubiquity. It is only rarely that a member of this group displays a restriction to a special type of environment. *F. rufibarbis gnava* appears to be the exception which proves the rule, for it is known only from shady canyons in the southwestern states. The rest of the species display considerable tolerance for type of nest site and some of them are exceptionally adaptable in their environmental relationships. In this particular *F. fusca* stands far ahead of any other species. As already noted this insect may be found nesting in the greatest variety of situations extending from sea level to high alpine meadows in the western mountains. This, coupled with its docility, makes *fusca* an almost ideal slave, hence it is frequently encountered in the nests of the slave-making species.

As far as is known all the members of the *fusca* group prefer to nest in soil. The nests are usually started beneath a covering object or at the base of grass tufts, but as the nest grows, considerable earth may be brought to the surface. This excavated soil may be piled into a loose crater or mound or spread out into a low bed around the nest openings. One interesting species, *F. montana*, often nests in natural hummocks which occur in the moraine prairies of the north central states. Miss Amstutz, who investigated a number of such nests at Killdeer Plain, Ohio, in 1943, is of the opinion that the ants move into the upper passages of the hummock during those periods when there is standing water on the surface of the plain. It may be added that *montana* often uses thatching on the surface of its nests, a trait which is as rare in the *fusca* group as it is common in the *rufa* group.

The following key does not contain *F. cinerea* var. *canadensis* Santschi or *F. fusca* var. *blanda* Wheeler. As I have shown elsewhere, neither of these forms can be successfully handled at present. It is my opinion that *canadensis* will prove to be a synonym of *altipetens* or *lepida* and that *blanda* may have to be dropped as impossible of exact determination. The omission of these two forms from the key should cause no difficulty.

Key to the species of the fusca group

1. The eyes and all surfaces of the antennal scapes covered with numerous, small, erect hairs; the rest of the body with very abundant and somewhat coarser erect hairs. . . . . *pilicornis*

The eyes and antennal scapes without erect hairs except for one or two at the tips of the scapes; erect hairs elsewhere, when present, sparse to moderately abundant....2

2. Gula with at least two erect hairs....3
   Gula without erect hairs....10
3. Worker caste strongly polymorphic; the head of the largest worker quadrate, as broad as long or broader than long (mandibles excluded)..4
   Worker caste feebly polymorphic or monomorphic; the head not quadrate, longer than broad (mandibles excluded)....6
4. Front, occiput and dorsum of the pronotum with a few conspicuous erect hairs....5
   Front, occiput and dorsum of the pronotum hairless or with one or two inconspicuous, semi-erect hairs....*subpolita* subsp. *ficticia*
5. Head and gaster piceous brown, the thorax only slightly lighter..*subpolita*
   Head castaneous brown, gaster piceous brown, the thorax notably lighter, yellow or brownish yellow....*subpolita* subsp. *camponoticeps*
6. Erect hairs present over the entire thoracic dorsum and usually on the crest of the petiole as well....7
   Erect hairs on the thorax confined to the pronotum or to the pronotum and mesonotum; absent on the epinotum and the crest of the petiole...9
7. Erect hairs present on the cheeks and abundant on the occipital angles *cinerea* subsp. *lepida*
   Erect hairs absent on the cheeks, sparse or absent on the occipital angles....8
8. Seen in profile the anterior edge of the mesonotum is distinctly raised above the level of the pronotum and descends to it through a short anterior declivity; erect hairs usually present on the occipital angles; length of female 8–10 mm....*montana*
   Seen in profile the anterior edge of the mesonotum is only slightly or not at all raised above the level of the pronotum, the two usually form a single convexity broken only by the slight impression at the promesonotal suture; erect hairs usually absent on the occipital angles; length of female 6–8 mm....*altipetens*
9. Gula with several erect hairs, those on the thorax short and mainly confined to the pronotum; scale of the petiole narrow, the crest strongly projecting upward in the middle....*sibylla*
   Gula with only two erect hairs, those on the thorax equally numerous on the pronotum and mesonotum; scale of the petiole broad, the crest flattened or at most feebly convex....*hewitti*
10. The portion of the gena lying between the eye and the insertion of the mandible evenly covered with coarse, elongate punctures, the surface between them finely granulose; eyes of the largest workers with their lateral margins not quite reaching the margin of the head when viewed in full face....11
    Genae without coarse, elongate punctures or with only a few such punctures immediately in front of the eye, the remainder of the surface with fine circular punctures with the surface between them shagreened

or delicately coriaceous; the lateral margin of the eyes reaching or projecting a little beyond the margin of the head when viewed in full face..13

11. Erect hairs on the gaster sparse, largely confined to a row of widely spaced, short, blunt hairs at the posterior edge of each segment; gastric pubescence very dilute, not sufficiently thick to obscure the distinctly shining surface ..... *neorufibarbis* subsp. *algida*

Erect hairs on the gaster more numerous and scattered over the entire dorsum; gastric pubescence dense enough to obscure the shining surface and give to the gaster a distinct grey cast 12

12. Thorax deep reddish brown to blackish brown, at least the pronotum heavily infuscated and only a little lighter in color than the head and gaster ..... *neorufibarbis* subsp. *gelida*

Thorax clear red to reddish yellow, sometimes lightly infuscated with spots of brown but always distinctly lighter in color than the head and gaster ..... *neorufibarbis*

13. Length of the antennal scape in the largest workers slightly less than the distance from the middle of the clypeal border to the middle of the occipital border, the scape strongly curved and thick at the tip.. *pruinosa*

Length of the antennal scape in the largest workers equal to or slightly longer than the distance from the middle of the clypeal border to the middle of the occipital border, the scape moderately curved and not unusually thick at the tip 14

14. The entire upper surface of the insect, with the exception of the mandibles, finely and densely granulose, completely opaque even to the posterior edges of the gastric segments; head and thorax dull ferrugineous red, gaster blackish brown ..... *rufibarbis* subsp. *occidua*

Upper surface of the insect feebly to moderately shining, the majority of the surface finely shagreened or coriaceous but not densely granulose; color not as above 15

15. Dorsum of the first gastric segment with erect hairs scattered over the entire surface; gastric pubescence usually sufficiently heavy to obscure to some extent the surface of the gaster 16

Dorsum of the first gastric segment with the erect hairs limited entirely or in large part to the row at the rear edge of the segment, at most not more than two or three erect hairs elsewhere; gastric pubescence very dilute, not obscuring the surface which is moderately shining... *marcida*

16. Clypeal carina seen from above broad, blunted and indistinct; anterior margin of the clypeus broadly and evenly rounded, never angular in the middle and very rarely reflected upward; at least a part of the thorax and the anterior half of the head yellow or reddish 17

Clypeal carina seen from above sharp and distinct; the anterior margin of the clypeus usually reflected slightly upward and often obtusely angular in the middle; concolorous, brownish black to piceous black ..... *fusca*

17. Epinotum distinctly higher than long, the basal face sloping sharply downward and usually passing to the posterior face through an angle so much rounded that the two faces form a single even convexity over much of their length; crest of the petiole usually notched ..... *neoclara*

Epinotum about as high as long, the basal face not sloping sharply downward, the angle between it and the declivious face well marked; crest of the petiole usually entire . . . . . *rufibarbis* subsp. *gnava*

68. Formica altipetens Wheeler

F. cinerea var. *altipetens* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 523 (1913) ♀ ♀ ♂.

Type loc: Florissant, Colorado. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: Montana south through the Rockies to Mexico and west to the Pacific Coast. The insect also occurs in the mountains of Utah and northern Arizona but seems to be rare in Nevada and Idaho.

For the revisionary data on *F. altipetens* see the discussion at the beginning of the *fusca* group.

69. Formica cinerea lepida Wheeler

F. cinerea var. *lepida* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 526 (1913) ♀.

Type loc: Blue Lake, Humboldt County, California. Types: M.C.Z.

Range: western Dakotas to the Pacific Coast. The insect does not appear to occur further south than Utah.

For the revisionary data on *F. cinerea lepida* see the discussion at the beginning of the *fusca* group.

70. Formica cinerea *var.* canadensis Santschi

F. cinerea var. *canadensis* Santschi, Ann. Soc. Ent. Belg., Vol. 57, p. 435 (1913) ♀ ♀.

Type loc: Saskatchewan, Canada. Types: none in this country.

It seems impossible to determine the nature of Santschi's *canadensis* without reference to the types. For this reason I have made no attempt to evaluate the status of *canadensis* or to include it in the key. Wheeler was of the opinion that the insect might possibly be his *hewitti*. This seems unlikely for *hewitti* usually occurs at considerable elevations in the mountains even at the northern end of its range. The occurrence of *hewitti* on the plains of Saskatchewan would be a very unusual circumstance. It seems to me that *canadensis* must be either *altipetens* or *lepida*. Santschi's record is of interest in any case since, if the insect actually belongs to the *cinera* complex, it represents the first record of a member of this group from Canada.

71. Formica fusca Linné

F. fusca Linné, Syst. Nat. Edit. 10, Vol. 1, p. 580 (1758); Mayr, Europ. Formicid., p. 47 (1861) ♀ ♀ ♂; Forel, Fourmis Suisse, p. 56 (1874) ♀ ♀ ♂; E. André, Spec. Hym. Europe, Vol. 2, p. 182, pl. 5, fig. 12 (1882) ♀ ♀ ♂; Emery, Deutsche Ent. Zeitschr., p. 196 (1909) ♀ ♀ ♂; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 494 (1913) ♀ ♀ ♂; Donisthorpe, British Ants, p. 304 (1915) ♀ ♀ ♂; Bondroit, Ann. Soc. Ent. France, Vol. 87, p. 48 (1918) ♀ ♀ ♂.

F. fusca var. *subsericea* Say, Boston Jour. Nat. Hist., Vol. 1, p. 289, (1836) ♀ ♀; Emery, Zool. Jahrb. Syst., Vol. 7, p. 659 (1893); Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 499 (1913) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 618, pl. 22, fig. 84 (1947) ♀.

F. fusca var. *subaenescens* Emery, Zool. Jahrb. Syst., Vol. 7, p. 659 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 504 (1913) ♀ ♀ ♂.

F. fusca var. *argentata* Wheeler, Amer. Naturalist, Vol. 36, p. 952 (1902) ♀ (*nec* Fabricius).

F. fusca var. *argentea* Wheeler, Psyche, Vol. 19, p. 90 (1912); Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 501 (1913) ♀ ♀ ♂.

F. fusca var. *glacialis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 24, p. 624 (1908) ♀ ♀ ♂.

F. lecontei Kennedy & Dennis, Ann. Ent. Soc. Amer., Vol. 30, p. 542 (1937) ♀ ♀ ♂.

Type loc: Europe. Types: none in this country.

Range: in North America, Newfoundland west to Alaska and the entire northern half of the United States. The southern limit of the range lies near the 38° parallel except in the larger mountain ranges where it extends further to the south.

For the revisionary data on the forms which have been synonymized with *F. fusca* see the discussion at the beginning of the *fusca* group.

The total number of taxonomic observations dealing with *F. fusca* is now so large that it would require several pages to carry all the references. Since many of these publications appeared in inaccessible journals and since a number of the older descriptions are of little present use, the above list has been rigorously limited. It carries a very small percentage of the descriptions of the typical *fusca* but in the case of the synonymized varieties a more complete presentation has been made in order that references given in the introduction to *fusca* may be easily verified.

72. Formica fusca *var.* blanda Wheeler

F. fusca var. *blanda* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 510 (1913) ♀.

Type loc: Olympia, Washington. Types: A.M.N.H., M.C.Z.

I have made no effort to treat *blanda* with the other variants of *fusca* or to include it in the key. At present any effort to deal with this insect seems certain to add more confusion to that which already exists. When Wheeler described *blanda*, he based the original description on twelve workers from Olympia, Washington; six workers from Seattle, Washington; four workers from Lemon Cove, Tulare Co., California and two workers from the Yosemite Valley. In his description of *blanda* Wheeler stated that "there is little variation in the series of workers examined." But later he discovered that specimens from Seattle and Lemon Cove are actually the insect which he described as *F. cinerea* var. *lepida*. The two specimens from the Yosemite were afterwards doubtfully referred to *marcida*. This leaves the twelve workers from Olympia, Washington as the only authentic specimens of *blanda*. All these are small workers measuring from 3–3.5 mm. Since there is so much convergence in the small workers of the *fusca* complex, it seems futile to hazard an opinion as to what the twelve little workers of *blanda* represent. The situation might possibly be bettered by extensive collecting in the type locality, for with adequate material for comparison it is not impossible that something might be made of the type specimens. On the other hand, it is entirely likely that nothing can be done to better the status of *blanda* and it will have to be dropped as an unrecognizable form.

73. Formica hewitti Wheeler

F. hewitti Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 552 (1917) ♀ ♀ ♂.

Type loc: Emerald Lake, British Columbia. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: mountains of Colorado, Utah and eastern Nevada north to British Columbia and Alberta.

This insect is much more widely distributed in the mountains of the west than the published records indicate. I have taken it in Colorado, Utah, Wyoming, Montana, Idaho, Washington and eastern Nevada. In the southern part of its range *hewitti* usually occurs at elevations well in excess of 8000 feet. Superficially *hewitti* is very much like *fusca* and, since the two insects behave in much the same fashion in the field, it is probable that there has been considerable confusion between them. I cannot, however, agree with Wheeler that they intergrade. It must be admitted that the workers of the two species are remarkably similar in appearance and, since the separation of the two is usually based on a pattern of erect hairs on the gula

and promesonotum of *hewitti*, it follows that abraded specimens of *hewitti* are often difficult to separate from *fusca*. There is, however, a constant structural difference shown by the females of the two species which is much easier to use. In *hewitti* the female has a slightly depressed area immediately in front of the eye and from this area across the gena to the insertion of the mandible are a number of coarse oval punctures between which is a delicately shagreened surface. In the female of *fusca* there is no depressed area in front of the eye and from that point to the insertion of the mandible the surface is mainly coriaceous with very fine, obscure, circular punctures, although there may be a few coarse punctures close to the anterior border of the eye. I have been able to examine eight females of *hewitti* taken from nests in six widely separated localities and they show a remarkable constancy in this character. I have no doubt that the two species are distinct even though the workers are very similar.

74. Formica marcida Wheeler

F. fusca var. *marcida* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 503 (1913) ♀ ♀.

Type loc: Prairie Hills, Selkirk Mountains, British Columbia. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: the Yukon southward through British Columbia to the mountains of central California, Utah and Wyoming.

The eastward range of *marcida* is much more extensive than has previously been supposed. It also has a much greater tolerance for elevation than was indicated by the earlier records. There is no doubt whatever that the insect occurs in alpine and boreal areas but, like so many other supposedly 'alpine' forms, it is by no means limited to such areas. It is interesting to note that *marcida* occurs as far south as Cedar Breaks, Utah, where it nests in the heavy stand of conifers which rims the edge above the canyons.

75. Formica montana Emery

F. subpolita var. *montana* Emery, Zool. Jahrb. Syst., Vol. 7, p. 663 (1893) ♀.

F. montana Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 529 (1913) ♀.

F. cinerea var. *neocinerea* Wheeler, Ibid. p. 524 (1913) ♀ ♀ ♂.

F. cinerea var. *rutilans* Wheeler, Ibid. p. 525 (1913) ♀.

Type loc: Nebraska. Types: M.C.Z.

Range: Ohio west to Colorado. In the latter state it occurs at comparatively low elevations.

I believe that I am correct in stating that *montana* does not occur in California. I regard the California records which Wheeler published for *neocinerea* as belonging to *altipetens*. All the California specimens which I have examined have had the occipital angles bare of hair and, while they are less constant in thoracic structure than might be wished, the majority of them possess the evenly convex promesonotum characteristic of *altipetens*. The reasons for treating *neocinerea* and *rutilans* as synonyms of *montana* have been discussed at the beginning of the *fusca* group.

76. Formica neoclara Emery

F. fusca var. *neoclara* Emery, Zool. Jahrb. Syst., Vol. 7. p., 661 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 509 (1913) ♀ ♀ ♂.

F. fusca pruinosa var. *lutescens* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 549 (1917) ♀.

Type loc: Colorado. Types: none in this country.

Range: northern New Mexico to Montana. The eastern boundary of the range appears to lie in the Black Hills of South Dakota. On the west it runs irregularly northwestward from Utah to Washington. This ant usually nests in foot hill regions and even in New Mexico does not occur at elevations in excess of 7000 feet. Oslar's Colorado records, which Wheeler published in 1917 (10,500 and 12,000 feet), are patently incorrect.

There has been considerable confusion in regard to *neoclara* and the writer may have added to this by treating *lutescens* as a synonymic form. The exact status of *lutescens* is problematical for it was described from small workers only. It seems quite clear, however, that *lutescens* has nothing in common with *pruinosa* and it is difficult to see why Wheeler made *lutescens* a variety of that form when it so exactly resembles the small worker of *neoclara*. I believe that the explanation turns upon the fact that Wheeler never recognized the variable coloration which marks *neoclara* over most of its range. It happens that the specimens from Colorado and New Mexico show less variation in color than do those which come from other parts of the range. Such specimens usually lack thoracic infuscation entirely and often the head is very lightly infuscated, although it is usually darker than the thorax. It is interesting that all the records which Wheeler published for *neoclara* come from Colorado and New Mexico. I think it is highly likely that he assigned the darker specimens to *neorufibarbis*. But these darker specimens which often occur in Utah and Montana, frequently show extensive infuscation of the thorax, particularly in the smaller workers. This infuscation is not uniform but has a curious

mottled character. It is, in short, exactly like the color in *lutescens* and, what is more important, rather unlike the coloration of any of the other forms. On this basis and also because of the shape of the epinotum of *lutescens*, I have made it a synonym of *neoclara*. It is possible, however, that when this form is better known it may be possible to consider it as a western race of *neoclara*. Up to the present, however, I have not been able to satisfy myself that there is any significant spatial relationship of the light and dark phases of *neoclara* for, although the dark phases are less frequently encountered in Colorado and New Mexico, they occasionally occur in both states.

Before leaving *neoclara*, it is necessary to add a word or two about the epinotal structure of this species. It has generally been assumed that a much rounded epinotal angle is characteristic of *neoclara* and this feature has been used as one of the main points for its recognition. When fully developed, this is certainly a striking characteristic but one which is subject to considerable variation. I have yet to see a substantial series of *neoclara* workers in which some of the individuals did not show a clearly marked epinotal angle and sometimes this condition will be found in the majority of the series.This does not mean that epinotal structure is of no significance in *neoclara*. But it does mean that the amount of rounding of the epinotal angle is not the important point. A much better character lies in the steep slant of the basal face of the epinotum. The epinotum of *neoclara* is short and high and the basal face descends rather precipitously from the level of the mesoepinotal suture. It does so whether the angle between the faces is rounded or not and hence is a more reliable if less spectacular character. It must be admitted, however, that unless one has had considerable experience it is easy to confound specimens of *neoclara* in which the epinotum is angular with *neorufibarbis*. Since the two species can be separated on less confusing cephalic characters, I have made limited use of epinotal structure in keying out *neoclara*.

77. Formica neorufibarbis Emery

F. fusca var. *neorufibarbis* Emery, Zool. Jahrb. Syst., Vol. 7, p. 660 (1893) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 507 (1913) ♀ ♀; Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 546 (1917) ♀ ♀ ♂.

Type loc: Hill City, South Dakota (by Wheeler's restriction). Types: M.C.Z.

Range: Alaska and British Columbia south to the mountains of central California, northern Arizona and northern New Mexico. The eastern limit of the range appears to terminate in the Black Hills of South Dakota.

The typical *neorufibarbis* and its subspecies *gelida* are both western forms and one would judge from published locality records that they occur in the same stations. The two are separated by elevation. The range of *neorufibarbis* is always below that of *gelida*. The former insect occurs on the high plains and the outlying spurs of the mountains, where it may range up to 9000 feet in southern latitudes. The distribution of *gelida* on the other hand is from the top down, with few southern records below 8000 feet and many from much higher elevations. As may be seen, there is a considerable overlap in the ranges and much of the material is intermediate in character. But it seems to be uniformly true that in any given area the lowland forms all have the characteristics of *neorufibarbis* and the high level forms those of *gelida*. The two can, therefore, be regarded as geographical races which occupy different elevational ranges.

There are so many characteristics in which *neorufibarbis* and its two subspecies differ from *fusca* that the wonder is that they have been allowed to remain so long as nothing more than varieties of that species. The worker caste in *neorufibarbis* is much more variable in size than that of *fusca*. The head of the large worker is distinctly broader with the sides sloping inward more sharply toward the insertion of the mandibles and the eyes placed nearer the mid-line. The clypeus is less projecting, the genae have a characteristic sculpture (see key) and the thorax is shorter and higher. It is hard to see what more one could want as a basis for specific status and I have no hesitation in treating *neorufibarbis* as a separate species.

78. Formica neorufibarbis algida Wheeler

F. fusca var. *algida* Wheeler, Psyche, Vol. 22, No. 6, p. 205 (1915) ♀ ♀.
Type loc: Kittery Point, Maine. Types: A.M.N.H., M.C.Z.
Range: Labrador and eastern Canada south to New England and west to Minnesota.

Wheeler was of the opinion that *algida* nests only in sphagnum bogs and this may be true in the eastern part of its range. But Gregg has recently shown (1946) that in Minnesota it nests in upland woods as often as in bogs. At present there appear to be no records of *algida* intergrading with *gelida* but it probably does so in Manitoba, since the range of *gelida* extends eastward to Saskatchewan.

79. Formica neorufibarbis gelida Wheeler

F. fusca var. *neorufibarbis* Pergande, Proc. Wash. Acad. Sci., Vol. 2, p. 519 (1900) ♀; Forel, Ann. Soc. Ent. Belg., Vol. 48, p. 153 (1904) ♀ ♀ (*nec* Emery).

F. fusca var. *gelida* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 505 (1913) ♀ ♀ ♂.

Type loc: Ward, Colorado (9000'). Types: A.M.N.H., M.C.Z.

Range: Alaska, British Columbia, Alberta and Saskatchewan with southern extensions through the Sierras to northern California and through the Rockies to northern New Mexico. In the United States the insect does not appear to occur east of the Rockies.

80. Formica pilicornis Emery

F. fusca var. *cinerea* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 427 (1886) ♀ (*nec cinerea* Mayr 1853).

F. pilicornis Emery, Zool. Jahrb. Syst., Vol. 7, p. 664 (1893) ♀ ♀ ♂.

F. cinerea subsp. *pilicornis* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 527 (1913) ♀ ♀ ♂.

Type loc: Tres Pinos, California. Types: none in this country.

Range: San Francisco south to Lower California. This species nests at low elevation in the foot hills of the Coastal Range and the San Bernardino Mountains.

The type locality of *pilicornis* is clearly Tres Pinos. The specimens from San Jacinto mentioned by Emery should not, in my opinion, be considered a part of the type series. I mention this because specimens from San Jacinto are marked as types in the Wheeler Collection at Harvard. The reasons for restoring *pilicornis* to specific rank have been discussed at the beginning of the *fusca* group.

81. Formica pruinosa Wheeler

F. fusca subsp. *pruinosa* Wheeler, Proc. Amer. Acad. Arts Sci. Boston, Vol. 52, p. 548 (1917) ♀ ♀ ♂.

Type loc: Emerald Lake, British Columbia. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: southern Alberta, British Columbia and western Montana.

Wheeler was of the opinion that *pruinosa* is closely related to *neoclara* but, except for a similar coloration, the two species appear to have little in common. The outstanding peculiarity of *pruinosa* is to be found in its short, thick and rather strongly curved antennal scapes. These distinguish *pruinosa* from either *neoclara* or *fusca*. It also has a rather characteristic petiolar scale which is not so broad from side to side as that of *fusca* and not so blunt at the crest as that of *neoclara*. It is a smaller insect than either of the above species, the length of the worker not exceeding 4 mm.

82. Formica rufibarbis occidua Wheeler

F. rufibarbis Wheeler, Amer. Naturalist, Vol. 36, p. 947 (1902) ♀ (*nec* Fabricius).

F. rufibarbis var. *occidentalis* Wheeler, Ants, Columbia Univ. Press, p. 570 (1910) (*nec* Buckley).

F. rufibarbis var. *occidua* Wheeler, Psyche, Vol. 19, p. 90 (1912) (*nomen novum*); Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 517 (1913) ♀ ♀.

Type loc: Palo Alto, California. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: coastal mountains of California north to Washington.

This species constructs nests beneath stones in open groves and is an aggressive and pugnacious insect, a very unusual attribute for a member of the *fusca* group. Its color is also out of the ordinary, since it possesses a reddish head and thorax and a blackish gaster, a combination very similar to that characteristic of the *rufa* group. The taxonomic history of *occidua* has been most unfortunate. Wheeler originally mistook the insect for the typical *rufibarbis*. Later he rectified this error only to make another, when he gave to it the preoccupied name, *occidentalis*. In 1912 Wheeler changed the name to *occidua* but it was not until a year later that he presented what may be regarded as a valid description of this very distinct subspecies.

83. Formica rufibarbis gnava Buckley

F. gnava Buckley, Proc. Ent. Soc. Phila., Vol. 6, p. 156 (1866) ♀ ♀ ♂.

F. fusca var. *gnava* Wheeler, Trans. Texas Acad. Sci., Vol. 4, p. 19 (1902).

F. rufibarbis var. *gnava* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 518 (1913) ♀ ♀ ♂.

F. foreliana Wheeler, Ibid. p. 451 (1913) ♀.

Type loc: central Texas (by Wheeler's 1902 restriction). Types: none known to exist.

Range: central Texas south into Mexico and west to the Mojave Desert. The insect also occurs sporadically in southern Colorado and Utah.

It is surprising to find that the insect which Wheeler described as *F. foreliana* is actually a synonym of *F. rufibarbis* subsp. *gnava*. The writer has never been able to understand Wheeler's treatment of *foreliana*. A number of points which clearly indicate a relationship with the *fusca* group were cited in the original description of the species, hence we cannot assume that Wheeler was unaware of these characteristics. Indeed, he used one of them (the opaque frontal area)

as the key character by which *foreliana* was to be separated. Yet despite the opaque frontal area and despite the subparallel frontal lobes and the unusually elongate and slender antennae, Wheeler placed *foreliana* in the *rufa* group. It seems logical to suppose that, having done so, Wheeler would have compared *foreliana* to one of the species in that group. Instead he compared it to *rubicunda*, whose smaller workers it was said to resemble closely. This resemblance was said to be especially noticeable in the shape of the thorax, the petiole and in the pilosity. But, since *foreliana* admittedly had no relationship to the *sanguinea* group, it is difficult to see what Wheeler was attempting to show by pointing out these similarities. It may be added that in no case is there anything more than a very superficial resemblance which, under the circumstances, is what might be expected. I have had occasion on a previous page to mention that color plays an important part in the recognition of species belonging to the *fusca* group. I pointed out that while the color of the members of the *fusca* group varies, they usually differ notably from the bicolored *rufa* pattern. It follows that if a member of the *fusca* group should happen to have a coloration similar to that of the *rufa* group, there would be a good chance for it to be misassigned. In my opinion this is the only understandable explanation for Wheeler's treatment of *foreliana*.

I had been prepared to shift *foreliana* to the *fusca* group but I confess that it was startling to discover that it was a synonym of *gnava*. Of this there can be no reasonable doubt, for the two insects differ in no way except that in the types of *foreliana* the erect hairs of the pronotum are a little more numerous and those of the gaster slightly longer than in specimens which Wheeler considered the typical *gnava*. I feel certain that neither of these differences is a matter for separation. This conclusion is based on a long nest series of workers which I took in Ramsey Canyon in the Huachuca Mountains. In this series are individuals which could be assigned with perfect agreement to *foreliana* and others whose pilosity would make it necessary to place them with *gnava*. It may be recalled that the type locality of *foreliana* is in the Huachuca Mountains and that in this same area Wheeler recorded the presence of *gnava*. It would, therefore, seem that *foreliana* is at most a nest variety of *gnava* and I propose to treat it as a synonym.

The distribution of *gnava* in California presents some puzzling features. Wheeler recorded the insect from Needles and several years ago I doubtfully referred to *gnava* some minor workers from Riverside County sent me by Mr. Mallis. I now believe this to have been a misidentification. There would seem to be no reason why *gnava* should not occur widely in southern California for it nests in canyon

bottoms and should find suitable nest sites in the southern California area. But if, as seems likely, the distribution of *gnava* in California is limited to the eastern edge of the Mojave Desert, there is a considerable gap between the range of *gnava* and that of the subspecies *occidua*. Since the sculpture of the two forms is quite unlike and, since they prefer different types of nest sites, there is nothing whatever to indicate that they are behaving as geographical races. It seems likely that we may ultimately have to treat these two insects as separate species but before this can be verified we will have to know more about the distribution of *gnava* in California.

It is usually easier to identify *gnava* in the field than from cabinet specimens. The insect shows a striking similarity to the darker specimens of *neoclara*. Not only is the color of the two very much alike but the gastric pubescence is virtually identical. The structural features which distinguish the two species have been given in the key and need not be repeated here. In the field *gnava* is easily distinguished from *neoclara*. The nests of *gnava* are decidedly larger, it is notably more aggressive and it possesses the distinctive '*rufibarbis* odor'.

84. Formica sibylla Wheeler

F. sibylla Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 530 (1913) ♀ ♂.

Type loc: King's Canyon, Ormsby Co., Nevada. Types: A.M.N.H., M.C.Z.

Range: central Sierras of California to the Cascades of Oregon.

The nests of *sibylla* are usually obscure craters built in sandy soil. Those which Wheeler observed in the Yosemite were fully exposed to the sun. On the eastern slopes of the Cascades the insect nests in open coniferous woods.

85. Formica subpolita Mayr

F. fusca var. *subpolita* Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 426 (1886) ♀ ♀.

F. fusca subsp. *subpolita* Emery, Zool. Jahrb. Syst., Vol. 7, p. 661 (1893) ♀ ♀.

F. subpolita Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 532 (1913) ♀ ♀ ♂.

F. rufiventris Emery, Zool. Jahrb. Syst., Vol. 7, p. 665, pl. 22, fig. 11, (1893) ♂ (*nec* Fabricius).

F. flammiventris Wheeler, Psyche, Vol. 19, p. 90 (1912) ♂.

Type loc: San Francisco (by Wheeler's restriction, 1913). Types: none in this country.

Range: Coastal Range of California north to Washington.

In the southern part of its range *subpolita* occurs at elevations up to 6000 feet. It is, however, generally found at lower levels and is common at sea level in the vicinity of San Francisco. The eastward range in Washington and Oregon is more extensive than in California. In the two former states the insect occurs on the eastern slopes of the Cascade Range and in this area it intergrades with the subspecies *camponoticeps*.

86. Formica subpolita camponoticeps Wheeler

F. subpolita var. *camponoticeps* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 535 (1913) ♀.

Type loc: Wawawai, Washington. Types: A.M.N.H., M.C.Z.

Range: Sierras of California north into the Cascades of Oregon and Washington and eastward through the mountains of Nevada. Mallis has recorded *camponoticeps* from the San Bernardino Mountains but it seems probable that this record belongs to the typical *subpolita*.

The subspecies *camponoticeps* is clearly a geographical race whose main distinction from the typical form lies in its lighter color. As may be recalled, Wheeler was of the opinion that the two forms are best separated by the broader head of the major of *camponoticeps*. I doubt this distinction for I have taken broad-headed majors from nests of the typical *subpolita* that were, in all respects but their color, like those of *camponoticeps*. Wheeler was also of the opinion that the colonies of *camponoticeps* are smaller than those of *subpolita*, but this difference has not been particularly noticeable in the colonies which I have been able to observe in the field. It may be that I have never seen a fully developed nest of the typical *subpolita* for most of my observations were made in the northern part of the range of this insect. The nests of *camponoticeps* which I have seen were built under stones in harsh, gravelly soil in fully exposed situations. In this they differed from the nests of the typical *subpolita*, which were found in sandy soil in open pine groves. I am not inclined to attach much significance to this difference for it seems clear that both forms show considerable adaptability in the matter of nest sites.

87. Formica subpolita ficticia Wheeler

F. subpolita var. *ficticia* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 561 (1913) ♀ ♀ ♂.

Type loc: Helena, Montana. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: Rocky Mountain region from Colorado to Montana and the mountains of Utah.

This subspecies might be expected to intergrade with *camponoticeps* in the mountains of western Utah and eastern Nevada but it does not seem to do so. It is probable that intergrades will be found in northern Idaho and eastern Washington.

Subgenus NEOFORMICA Wheeler

Since the present work proposes certain revisionary changes in the *pallidefulva* complex, it has been necessary to review some of the stages in the development of that group. This has been singularly difficult to do, not only because of taxonomic complication but also because of the exasperating inconsistencies which have marked the treatment of these forms. I refer in particular to the unusual fashion in which both Emery and Wheeler attempted to handle *schaufussi*, *nitidiventris* and *incerta*. This last form, indeed, may be regarded as something of a curse as far as Neoformica is concerned. It is not too much to say that it represents the principal stumbling block that prevents a proper appreciation of the *pallidefulva* complex. Oddly enough the main difficulty arises from the fact that both Wheeler and Emery considered *incerta* to be an intergrade. Both men were much concerned with the morphological instability of *incerta*, a phenomenon which they apparently found of more interest than the structural stability of other variants in the *pallidefulva* complex. The end result has been to produce the impression that there is not enough structural constancy in the *pallidefulva* variants to allow any of them to be given specific status. I propose to show that this view is incorrect and that the proper treatment of the *pallidefulva* complex will permit the recognition of separate species within the assemblage. To do so it will be necessary to review briefly certain steps by which the complex was given its present form.

The first observation on the structural instability of *incerta* was published more than half a century ago. In 1893 Emery undertook a study of *pallidefulva* which led to the subordination of Mayr's *schaufussi* as a subspecies and to the establishment of two new subspecies, *nitidiventris* and *fuscata*. In addition Emery set up the variety *incerta*. There were several remarkable features about this variety. Although it was definitely regarded as belonging to *schaufussi*, from which it differed in its less abundant erect hairs and thinner pubescence, Emery made it plain that a great deal of latitude was necessary in dealing with the definitive characteristics of *incerta*. He called attention to the fact that workers of this variety coming from different nests formed a transitional series of stages between *schaufussi* and

nitidiventris. Perhaps this is why Emery made no attempt to key out *incerta*. In his key he brought it out with *schaufussi* and made no reference there as to how the two were to be distinguished. This is scarcely surprising in view of Emery's statement as to the intergrading character of *incerta* for it is clear that, if Emery was correct, *incerta* would defeat any attempt to separate *schaufussi* and *nitidiventris* in a key. What is surprising, and very unsatisfactory, is that Emery should have brought out *incerta* with *schaufussi* in his key. The matter plainly called for clarification yet when Wheeler monographed Formica in 1913 he made use of Emery's arrangement. He did so in the face of additional facts which made the arrangement seem still less logical. For Wheeler observed that it is often possible to find, within the limits of a single colony of *incerta*, individuals which are 'almost indistinguishable from *schaufussi*' and others which are 'equally close to *nitidiventris*'. Nevertheless Wheeler keyed out *incerta* as though that insect possessed its own distinctive characteristics of pilosity.

It requires no great perspicuity to realize that there is something wrong with the above situation. There is no way in which the conflicting statements made about *incerta* can be reconciled. For the data presented advocates two contradictory views. We are asked to believe that *incerta* connects *schaufussi* and *nitidiventris*, in which case any attempt to key the three forms is futile. But we are also told that they can be separated by means of a key, in which case it is necessary to believe that *incerta* does not connect *schaufussi* and *nitidiventris*. In view of these extraordinary inconsistencies, it is no wonder that other investigators have shown little enthusiasm for becoming involved in the *pallidefulva* problem.

I confess that if it were not a matter of necessity I would follow this discretionary course myself. But something has to be done with the mess and there is reason to believe that the actual situation is not as illogical as it has been made to appear. We now have a much sounder concept of the intergradation of subspecies than was current at the time when Wheeler and Emery became involved with *incerta*. It seems probable, therefore, that much of the above difficulty might be resolved by zoögeographical analysis for this type of study has been highly successful in dealing with the intergradation of subspecies.

On the basis of distribution the *pallidefulva* complex is divisible into two groups. In the southern United States and extending as far north as the latitude of Virginia there are *pallidefulva*, *succinea* and *dolosa*[1]. There are sporadic records of *pallidefulva* from points as far north as

[1] I have not included the subspecies recently described by M. R. Smith as *archboldi* in this analysis. The characteristics of *archboldi* seem to indicate rather clearly that it is a separate species and more closely related to *moki* than to *pallidefulva*.

New York but the great majority of the records for these forms come from stations south of Washington. The second group includes *schaufussi, nitidiventris, incerta* and *fuscata.* The main range of this group lies in a region which begins in southern Canada and extends through New England into the Middle Atlantic States and as far west as Wisconsin and Iowa. In addition, the last three variants (but not *schaufussi*) occur sporadically in several states in the Rocky Mountain Region. In this area also occurs the variant *delicata* but since this insect is known only from the type locality (Ten Sleep, Wyoming) it need not be considered here. In the eastern United States the southern limit of this second group of variants appears to correspond rather closely with the southern end of the Appalachian highlands. It follows, therefore, that in Virginia, North Carolina and Tennessee both northern and southern variants are present. If these variants are behaving as geographical races of a single species, it would be expected that in the area just mentioned all the variants would intergrade and as a result this region would show a very high percentage of transitional forms. In point of fact there is no more intergradation there than elsewhere. Moveover, some of the forms clearly do not intergrade in this region or anywhere else in their range. This is best shown by *dolosa* and *pallidefulva.* With the latter form I include the variant *succinea* which is, in my opinion, a synonym of *pallidefulva.* It happens that *dolosa* and *pallidefulva* are the only two variants of this complex which occur over a large region extending along the Gulf of Mexico from Florida to Texas. This greatly simplifies a study of their behavior. The matter is further expedited by the fact that the two insects are notably unlike in the character of their erect pilosity, hence there should be no difficulty in recognizing intergrades, assuming that these are produced. But while *pallidefulva* and *dolosa* occur in the same stations all along the Gulf Coast, the writer has never seen any evidence of intergradation between them. This may be asserted despite variations in the hair pattern of *pallidefulva.* The insect does not always show the lack of erect thoracic hairs which is supposed to mark its 'typical' condition. But when erect hairs are present on the thorax of *pallidefulva,* they are never overly abundant and there is no possibility of confusing such specimens with the densely hairy *dolosa,* for the latter is highly constant in its pilosity. What is more important, the two insects have a notably different petiolar scale. In *pallidefulva* the front face of the scale is only moderately convex from side to side and not convex at all from crest to base. Instead, the front face is rather angular in profile, with the vertical basal portion distinctly separated from the upper part which slopes rearward to the crest. The latter is narrow and rather sharp, so that the outline of the

scale when seen in profile suggests a rather dull chisel. In *dolosa* the scale of the petiole is notably thickened from front to back with the anterior face distinctly convex in two planes. When the scale is seen in profile, the anterior face usually forms a single convexity from the anterior peduncle to the crest or, if a basal vertical portion is visible, it is short and obscure. The crest of the scale is blunt and rounded with no suggestion whatever of an upper edge. In profile the outline of the scale rather strongly suggests the tip of an index finger. It may, therefore, be seen that the difference between *pallidefulva* and *dolosa* is not merely involved with the scarcity or abundance of the erect body hairs but is a more substantial matter in which the difference in pilosity is correlated with a different type of petiolar scale. Since *pallidefulva* and *dolosa* do not intergrade, there is reason to believe that the differences which they show are of more than subspecific significance.

Let us see if this difference might not also apply in the case of the northern variants. The typical *schaufussi* is extremely like *dolosa*, differing from it mainly in the somewhat shorter erect hairs on the promesonotum. The petiolar scale is identical in the two insects. Since the petiolar scale in *nitidiventris*, *incerta* and *fuscata* is like that of *pallidefulva*, there is excellent ground for the view that *schaufussi* is as distinct and constant in the north as is *dolosa* in the south. For if scale structure as well as pilosity is considered, it is clear that *schaufussi* does *not* intergrade with *incerta*. I believe, moreover, that the erect pilosity of *schaufussi* is consistently more abundant than that of *incerta*, although it must be admitted that the two insects are much more alike in this respect than are *pallidefulva* and *dolosa*. While it is possible to show that *schaufussi* and *incerta* to not intergrade, there seems to be no satisfactory way in which *incerta*, *nitidiventris* and *fuscata* can be separated. In contrast to the constancy which marks *dolosa* and *schaufussi*, these forms are highly variable in pilosity. It is exceptional to find a nest series of any length in which the pilosity is uniform throughout. By this I do not mean to imply that the full range of hairiness is displayed by every nest series. But in most cases there is sufficient overlap to render demarcation between the variants impossible. It is only by handling them collectively that any satisfactory treatment is possible.

The foregoing discussion should indicate clearly the nature of the changes which I propose for the *pallidefulva* complex. Since *schaufussi* and *dolosa* show none of the characteristics which they should exhibit as subspecies of *pallidefulva* and, since they behave as though they are representatives of a separate species, it seems best to treat them as such. While there is some overlap in the ranges of the two, the ma-

jority of the range of *schaufussi* is in the north, that of *dolosa* in the south. There is no reason, therefore, why *dolosa* should not be considered a southern race of *schaufussi*. While this eliminates some of the difficulty in the case of the *pallidefulva* complex, it by no means cares for all of it. There is the much more difficult problem of whether we can treat *nitidiventris* as a northern race of *pallidefulva*. As has already been noted, the overlap in the ranges of these two insects is very considerable in the eastern United States. But it must be remembered that the total range of each of these insects is much more extensive than the region in the eastern states where they occur together. Along the Gulf Coast from Florida to central Texas *pallidefulva* occurs but *nitidiventris* does not. Conversely *nitidiventris* is abundant in New England and southern Canada and extends from this region westward to the Rockies over an area where *pallidefulva* is absent. Since the two are so closely related from a structural standpoint, there would seem to be no possibility for treating them as separate species, hence it seems best to treat the forms as northern and southern races of the same species even though this involves a greater overlap of ranges than is ordinarily the case.

One further point in the taxonomy of the *pallidefulva* complex must be considered. It has been necessary to treat Cole's subspecies *delicata* as a synonym of *nitidiventris*. I feel considerable responsibility in the case of this subspecies for Dr. Cole sent me specimens before he described it and I gave him my opinion that it represented a distinct western race. I have since been forced to alter this view. As originally described, *delicata* was said to differ from *nitidiventris* because of its longer and narrower head and because of the presence of erect hairs on the crest of the petiole. From what has already been said, it should be clear that this second feature is of no significance as a separatory character. The crest of the petiole of *nitidiventris* frequently bears erect hairs. The matter of head shape, however, deserves more careful consideration. At the outset of his work with *pallidefulva*, Emery figured the head of *nitidiventris*. In his figure the head is approximately one-eighth longer than broad with the occipital border evenly convex, the eyes scarcely projecting beyond the sides of the head and the sides evenly converging from the eyes to the insertions of the mandibles. It may be added that Emery's figure is an excellent and accurate delineation of one type of individual which occurs in the nests of *nitidiventris*. But it will not apply at all to another type which is equally common. Here the head is at least one-quarter longer than broad, the sides in front of the eyes are parallel or nearly so and the eyes project strongly beyond the margin of the head. This at once suggests the phenomenon which marks many of the species of Formica in which

the width of the head varies with the size of the individual. Under such circumstances the larger the individual is, the wider its head will be. Because of the constancy of this correlation, it is entirely possible in such cases to use head width as a separatory character provided that workers of the same size are compared. In *pallidefulva* on the other hand, there appears to be no correlation between the size of the worker and the shape of the head. Either type of head may occur in any size of worker. It seems to be true that one type of head will usually predominate over most of a nest series. But the writer has yet to see any long nest series in which the head shape was entirely constant throughout. This is true even of the type series of *delicata*, or at least that part of it which I have been able to examine through the generosity of Dr. Cole. For the reasons just discussed, I cannot see how *delicata* can be separated from *nitidiventris* and have treated it as a synonym of that form.

Since the discussion of *pallidefulva* has been so protracted, it is fortunate that the habits of the members of Neoformica require no elaborate discussion. The colonies formed by these insects are comparatively small in size and the nests are usually rather obscure. They are generally built under stones or at the base of tufts of grass. Occasionally there is a ragged pile of excavated material at the nest entrance but more often this is carried well away from the nest opening, so that the latter is nothing more than an irregular hole, flush with the surface of the soil. These ants are extraordinarily timid and will usually make no effort whatever to defend the nest. At the least intrusion they will abandon the brood, although they often sneak back and try to rescue it later. Their lack of pugnacity makes them easy victims of various slave-making species.

Key to the species of Neoformica

1. Epinotum and mesopleurae opaque, densely and evenly coriaceous.....2
   Epinotum and mesopleurae moderately to strongly shining, the sculpture consisting of delicate shagreening which does not notably dull the surface.....5
2. Erect hairs present on the dorsum of the thorax and the crest of the petiole *archboldi*
   Erect hairs absent on the dorsum of the thorax and the crest of the petiole.....3
3. Crest of the petiole in profile comparatively narrow and not much rounded; pubescence inconspicuous on the head.....*moki*
   Crest of the petiole in profile thick and blunt; pubescence conspicuous on the head.....4
4. Color blackish brown, the posterior half of the head and the thorax as

deeply colored as the gaster.....*moki* subsp. *xerophila*
Head and thorax reddish brown, often blotched with black but always lighter in color than the gaster.....*moki* subsp. *grundmanni*

5. Anterior face of the petiole strongly convex both from side to side and from base to crest, the crest of the scale blunt and evenly rounded above with no trace of an angular upper edge.....6
Anterior face of the petiole moderately convex from side to side; seen in profile the sloping upper portion of the face forms a distinct angle with the perpendicular lower portion; crest of the scale distinctly angular above and usually with a sharp upper edge.....7
6. Erect hairs on the pronotum as long as those on the gaster; gastric pubescence dense and partially obscuring the surface sculpture; gaster little or no darker than the thorax.....*schaufussi* subsp. *dolosa*
Erect hairs on the pronotum distinctly shorter than those on the gaster; gastric pubescence not dense enough to obscure the surface sculpture; gaster usually darker than the thorax.....*schaufussi*
7. Color clear golden yellow, the gaster little or no darker than the thorax, its surface feebly shining.....*pallidefulva*
Head and thorax yellowish brown to piceous brown, the gaster notably darker, its surface moderately shining.....*pallidefulva* subsp. *nitidiventris*

88. Formica (Neoformica) archboldi M. R. Smith

F. (*N.*) *archboldi* M. R. Smith, Florida Entomol., Vol. 27, No. 1, p. 16 (1944) ♀.
Type loc: Archbold Biol. Sta., Lake Placid, Florida. Types: U.S.N.M.
Range: central Florida to southern Georgia.

Although Dr. Smith regards this insect as a variant of *pallidefulva*, it is my opinion that it should have specific status. I have not seen types of *archboldi* but Dr. Schneirla very kindly gave me material that came from the type locality if not from the type nest itself. It seems to me that if one had to make a choice, *archboldi* might better be referred to *moki* than to *pallidefulva*. However, no such choice is necessary, for if *moki* deserves specific distinction on the basis of its sculpture, then it is no more than logical to accord a similar treatment to *archboldi* for the same reason.

89. Formica (Neoformica) moki Wheeler

F. moki Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 22, p. 343 (1906) ♀.
F. (*N.*) *moki* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 558 (1913) ♀; M. R. Smith, Ann. Ent. Soc. Amer., Vol. 32, No. 3, p. 582 (1939) ♀.
Type loc: Bright Angel Trail, Grand Canyon, Arizona. Types: A.M.N.H., M.C.Z.
Range: northern Arizona and southern Utah.

90. Formica (Neoformica) moki grundmanni Cole

F. (*N.*) *moki* subsp. *grundmanni* Cole, Amer. Mid. Naturalist, Vol. 29, p. 184 (1943) ♀.

Type loc: Parleys Canyon, Salt Lake Co., Utah. Types: Coll. A. C. Cole, U.S.N.M., A.M.N.H., Coll. Dept. Zool. Univ. Utah.

Range: known only from type material.

91. Formica (Neoformica) moki xerophila M. R. Smith

F. (*N.*) *moki* subsp. *xerophila* M. R. Smith, Ann. Ent. Soc. Amer., Vol. 32, p. 583 (1939) ♀.

Type loc: Leavenworth, Washington. Types: U.S.N.M.

Range: known from type material only.

The differences which separate *xerophila* from *moki* are very distinct. It seems probable that when *xerophila* is better known it will be necessary to give it specific status. The presence of *xerophila* in the state of Washington is notable to those interested in distribution for this is, by a very substantial margin, the extreme western record for a member of Neoformica.

92. Formica (Neoformica) pallidefulva Latreille

F. pallidefulva Latreille, Fourmis, p. 174 (1802) ♀; Emery, Zool. Jahrb. Syst., Vol. 7, p. 656, pl. 22, fig. 16 (1893) ♀ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 369 (1904) ♀.

F. (*N.*) *pallidefulva* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 548 (1913) ♀ ♀ ♂.

F. pallidefulva var. *succinea* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 369 (1904) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10 (1913) ♀ ♀ ♂.

Type loc: no exact locality given, by inference the southeastern United States.

Types: none in this country. Specimens on which Emery based his 1893 redescription are present in the U.S.N.M. and M.C.Z.

Range: central Texas eastward to Florida and northeastward to the latitude of Washington. The insect occurs very sporadically as far north as New York, but most of the few northern records are restricted to the pine barren area in New Jersey.

93. Formica (Neoformica) pallidefulva nitidiventris Emery

F. schaufussi Mayr, (part) Verh. Zool-bot. Ges. Wien, Vol. 36, p. 472 (1886) ♀ ♂.

F. pallidefulva subsp. *nitidiventris* Emery, Zool. Jahrb. Syst., Vol. 7, p. 656, pl. 22, figs. 13, 19 (1893) ♀ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 370 (1904) ♀.

F. (*N.*) *pallidefulva* subsp. *nitidiventris* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 555 (1913) ♀ ♀ ♂.

F. pallidefulva subsp. *fuscata* Emery, Zool. Jahrb. Syst., Vol. 7, p. 656 (1893) ♀ ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 370 (1904) ♀.

F. (*N.*) *pallidefulva* subsp. *fuscata* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 557 (1913) ♀ ♀.

F. pallidefulva subsp. *schaufussi* var. *incerta* Emery, Zool. Jahrb. Syst., Vol. 7, p. 655 (1893) ♀ ♀ ♂; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 370 (1904) ♀.

F. (*N.*) *pallidefulva* subsp. *schaufussi* var. *incerta* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 554 (1913) ♀ ♀ ♂.

F. pallidefulva subsp. *delicata* Cole, Amer. Mid. Naturalist, Vol. 20, No. 2, p. 369 (1938) ♀ ♀.

Type loc: District of Columbia. Types: none in this country.

Range: southern Quebec and Ontario to the mountains of northern Georgia and westward to Wisconsin and Iowa. Also sporadically in foothill regions in Wyoming, South Dakota, Colorado and New Mexico.

In making the above synonymy I have given precedence to the name *nitidiventris* although the application of page precedence demands that the name *incerta* be employed. I believe that a departure from the rule is justified by the confusion which has consistently surrounded *incerta*. This matter and the reasons covering the above synonymy have been presented in the introductory paragraphs dealing with Neoformica.

94. Formica (Neoformica) schaufussi Mayr

F. schaufussi Mayr, Sitzber. Akad. Wiss. Wien, Vol. 53, p. 493, fig. 6 (1866) ♀.

F. pallidefulva subsp. *schaufussi* Emery, Zool. Jahrb. Syst., Vol. 7, p. 654, pl. 22, fig. 17, 18 (1893) ♀; Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 370 (1904) ♀; Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 552 (1913) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 618, pl. 22, fig. 82 (1947) ♀.

Type loc: 'North America'. Types: none in this country.

Range: southern Ontario and New England south to the mountains of North Carolina and Tennessee and west to Wisconsin and Iowa.

95. Formica (Neoformica) schaufussi dolosa Wheeler

F. pallidefulva subsp. *schaufussi* var. *meridionalis* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 20, p. 370 (1904) ♀ (*nec* Ruzsky).

F. pallidefulva subsp. *schaufussi* var. *dolosa* Wheeler, Psyche, Vol. 19, p. 90 (1912) (*nomen novum*).

F. (*N.*) *pallidefulva* subsp. *schaufussi* var. *dolosa* Wheeler, Bull. Mus. Comp. Zoöl. Harvard, Vol. 53, No. 10, p. 554 (1913) ♀ ♀.

Type loc: Bull Creek, Texas. Types: A.M.N.H., M.C.Z., Coll. W. S. Creighton.

Range: central Texas east to Florida and northeastward to southern Virginia.

Genus POLYERGUS Latreille

(Plate 57, figures 1–5)

In 1947 Dr. M. R. Smith presented a carefully prepared paper dealing with the North American representatives of Polyergus. This publication contains much valuable data and is particularly useful in that it brings together material that has been widely scattered through the literature. The bibliographic citations and the distributional records for the various forms are unusually complete. It is to be regretted that Dr. Smith, who evidently put a great deal of effort on this study, did not also undertake certain revisionary changes which are clearly needed in this genus. Dr. Smith retained Wheeler's *montivagus* as a valid subspecies and continued to recognize *umbratus* and *fusciventris* as varieties. On subsequent pages I have attempted to show that *montivagus* must be treated as a synonym of *lucidus*. Since *fusciventris* has, from the time of its original description, been recognized as an intergrade between *breviceps* and *bicolor*, there is no point in continuing to employ this name. The status of *umbratus* can be defended as a valid geographical race and it has been given subspecific rank in this volume. These considerations have made it necessary to modify the arrangement for the group which Dr. Smith presented. I completely agree with Dr. Smith, however, that there is much structural variation within both species and subspecies in this genus. The taxonomic implications of this variation have been considered in the following paragraphs.

The taxonomy of the genus Polyergus is much more intricate than might be inferred from the small number of forms which have been described. The representatives of Polyergus appear to be marked by an unusually high degree of morphological instability, but much of this variation seems to be without taxonomic significance. This fact has been more clearly recognized by European specialists than by those on this side of the Atlantic. No one can claim that Emery and Forel were hesitant about setting up varieties when they found them. For this reason it is all the more significant that neither of these myrmecologists ever saw fit to describe a variety or a subspecies for the form of *rufescens* which occurs in Europe. There is no lack of minor varia-

tion in *rufescens*, hence we must suppose that Emery and Forel had observed that these variations are not of sufficient significance to justify even varietal status in the case of the European form. This is a point of view which will, in my opinion, have to be realized in the case of several of the North American variants. There have been too many names given to inconsequential variations. This has had the effect of damaging the status of the valid forms, for it is easy to get the impression that all the described variants are equally trivial.

In dealing with Polyergus it must be borne in mind that variation within the species is such that characters which in other genera might constitute specific differences not infrequently appear within the limits of a nest series. The scape length of *lucidus*, for example, is highly variable. At one extreme will be workers with antennal scapes which notably surpass the occipital margin; at the other may be found individuals in which the scapes barely reach the occipital margin. There seems to be no connection between this condition and the size of the worker, nor is there always a correlation between head shape and the size of the worker although, as a rule, the smaller workers tend to have somewhat narrower heads than do the large ones. But head shape is itself liable to confusing variations. To cite *lucidus* again, it is possible to find workers with slender heads in which the sides of the head are suddenly narrowed in front of the strongly projecting eyes. In other workers the sides of the head are feebly convex, the head is only a little longer than broad and the eyes scarcely project beyond the margin. An equally drastic situation occurs in the thoracic structure of the female of *lucidus*. In some specimens the thorax is notably slender with its length almost three times its greatest width. In others the thorax is not more than two and a half times as long as wide with the proportion of the parts entirely unlike those of the long-bodied female. Finally, there is a notable tendency for an occasional worker to show a petiolar scale which approaches that of the female in structure. Instead of being rather narrow and high, the scale of such workers will be notably wider than high with an almost semicircular crest. It seems possible that such workers are pseudogynes. Although there is little in the thoracic structure to indicate this, the gaster is usually more voluminous than that of the ordinary worker.

In the face of the foregoing paragraph, it may seem foolish to claim that certain of the named variants can best be recognized by utilizing head shape and the character of the petiole. This proposition is, however, less contradictory than it appears at first sight. It involves the realization that the majority of the members of a colony will generally show the same features. If there is an adequate series of specimens available, it is possible to recognize atypical individuals as such and to

disregard their characteristics in making the determination. It seems scarcely necessary to state that it is always difficult and often impossible to determine single specimens or small series. It would appear that this consideration applies also to the description of new variants. In one or two cases where a short type series was used to found a new variety, additional material has shown that the supposed definitive characters are too variable to be of any separatory value.

The activities of Polyergus are so spectacular that the genus has long been a favorite for habit studies. All the species are obligatory slave-makers and they carry out their raids with great spirit and remarkable precision. They are adept at raiding tactics not only because of an inherent pugnacity but also because of a mandibular structure that gives them a distinct advantage in combatting other ants. The mandibles of Polyergus are sickle-shaped with pointed tips which can be easily driven through the head or thorax of a victim. But while the worker of Polyergus is a very efficient fighting machine it seems capable of doing little else. Wheeler has suggested (1910) that the falcate mandibles of Polyergus incapacitate it for ordinary nest activities. There can be no doubt that there are certain limitations involved. It is difficult to see how the mandibles could be used in any operation concerned with the handling of small delicate objects. It is possible, therefore, that the Polyergus workers are physically incapable of tending the brood in its younger stages. On the other hand, there is little reason to suppose that the failure of the Polyergus worker to enter into ordinary nest activities can be entirely attributed to its mandibular structure. This is certainly no handicap to regurgitation and the Polyergus worker could feed the brood even though it might have difficulty in handling it. Moreover, the falcate mandibles should be just as serviceable in carrying soil particles out of the nest as they are in carrying captured larvae and pupae into it. It seems to the writer that the Polyergus worker enjoys its leisurely existence not because it is physically unable to take part in nest activities, but because it is psychologically incapable of doing so. We may suppose that during the course of a long association with its slaves the nest reactions of Polyergus have become as rigidly fixed as are its raiding habits. There is no doubt that the reactions of this insect are amazingly inflexible. Wheeler has shown that, although Polyergus workers can feed on liquid food without help, they will not ordinarily do so unless they stumble into it by accident. Thus if their slaves are taken away, the Polyergus worker will starve to death in the presence of food which they are perfectly capable of using. This extraordinary situation certainly points to a fixity of habit which is far more rigid than that found in most species of ants.

The slave-raids of Polyergus are beautiful things to watch. They usually take place in the early hours of the afternoon during the months of July and August. The raiders leave their home nest in a compact body, quite unlike the straggling columns of *sanguinea*, and proceed directly to the nest to be raided. I cannot agree with Wheeler that the raiders alway enter the foreign nest without any hesitation. In the summer of 1926 I was able to make daily observations on the raids of a colony of *lucidus*. They were raiding a nest of *F. nitidiventris* which was situated in stony meadow soil. Each day the *nitidiventris* workers blocked up the nest entrance with soil and pebbles until there was barely room for one ant to pass through it. The raiders usually arrived at the *nitidiventris* nest between 2:00 and 2:15 P.M. The first Polyergus workers to arrive made no effort to enter the *nitidiventris* nest but set about enlarging the nest entrance. They rapidly removed the soil and pebbles (which shows that they can work at excavation when necessary) and soon had a hole about an inch across leading into the nest. By this time the entire column had arrived at the *nitidiventris* nest. Once the nest entrance was big enough to suit them, there was no further hesitation and the whole lot plunged into the nest. As a rule nothing happened thereafter for twenty or thirty seconds. But then up would come workers of *nitidiventris* running for dear life. For five to ten minutes after they had entered the nest none of the raiders appeared on the surface, although during that period other workers of *nitidiventris* would rush out of the nest from time to time. Then the first *lucidus* workers, each burdened with a larva or pupa, would begin to emerge. The trip back home was a much more straggling affair. Not infrequently by the time the first returning raider reached its home nest the column would be strung out for fifty yards, a marked contrast to its compact character on the outward march. The raids of *breviceps* are, in my opinion, less highly organized than those of *lucidus*. Perhaps this is because the colonies of *breviceps* are larger than those of *lucidus* and the greater number of workers in the raiding column makes for confusion. But certainly the columns are less compact and they seem to move with less dispatch. Wheeler has given a very accurate description (1910) of the way in which the leaders of the column are overtaken and passed by those behind them. This slight hesitation at the head of the column has been characteristic of every *breviceps* raid which the writer has seen.

On the basis of experiments conducted by Forel, Wasmann, Viehmeyer, Emery (1909) and Wheeler (1910) it is possible to present a fairly complete account of the nest-founding activities of the Polyergus female. The insect at first secures adoption by a colony of the host species. When the intruding female enters the host nest, she is at

once attacked by the workers. Her reactions seem to be determined by the number of her attackers. If this is large and she meets strong opposition, she kills a considerable proportion of the workers. If only a few workers are involved in the attack she may offer little resistance and avoid killing her assailants. In either case she does not immediately attempt to appropriate the host brood or to eliminate the rightful queen. On the contrary, she displays much interest in the host female, who shows no resentment at the presence of the intruder. For a week or more the two females live together without any signs of animosity and by that time the workers are accustomed to the Polyergus female and have ceased to show hostility toward her. She then kills the rightful female. Since the workers have already accepted the Polyergus female as a member of the colony, they tend her brood as though she were their own queen. The significance of nest-founding reactions to slave raids has been discussed in the introduction to the *sanguinea* group and need not be repeated here.

Key to the species of Polyergus

1. Antennal scapes reaching or surpassing the occipital border; gastric pubescence very dilute, the hairs widely spaced and inconspicuous.....2
   Antennal scapes not reaching the occipital border, often not surpassing the level of the lateral ocelli; gastric pubescence dense and giving the surface a distinct greyish sheen.....3
2. Cheeks flat; head and thorax, at least in part, moderately shining..*lucidus*
   Cheeks feebly concave; head and thorax subopaque.....
   lucidus subsp. *longicornis*
3. Sides of the head moderately convex, distinctly narrowed from the eyes to the insertion of the mandibles, the occipital angles strongly rounded; declivious face of the epinotum, in profile, with the top slightly overhanging the bottom; scale of the petiole, in profile, bulbous, the thickness just below the crest greater than that at the base.....4
   Head with the sides in front of the eyes parallel or nearly so, the occipital angles only moderately rounded; the declivious face of the epinotum, in profile, not overhanging above; the scale of the petiole, in profile not bulbous, as thick at the base as it is near the crest.....
   rufescens subsp. *umbratus*
4. Head very smooth and shining, thorax moderately shining; color clear, yellowish red.....*rufescens* subsp. *laeviceps*
   Head at least in part opaque, the surface densely shagreened; color variable but always darker than the above.....5
5. Head, thorax and gaster ferrugineous to brownish red.....
   rufescens subsp. *breviceps*
   Head brownish red, gaster piceous brown and distinctly darker than the head; color of the thorax variable, at times the entire thorax as deeply colored as the gaster.....*rufescens* subsp. *bicolor*

1. Polyergus lucidus Mayr

P. lucidus Mayr, Verh. Zool-bot. Ges. Wien, Vol. 20, p. 952 (1870) ♀ ♀ ♂; McCook, Proc. Acad. Nat. Sci. Phila., p. 376, pl. 19 (1880); Mayr, Verh. Zool-bot. Ges. Wien, Vol. 36, p. 424 (1886); M. R. Smith, Amer. Mid. Naturalist, Vol. 37, No. 3, p. 618, pl. 22, fig. 85, a (1947) ♀; M. R. Smith, Ibid. Vol. 38, No. 1, p. 153, fig. 1 (1947) ♀.

P. rufescens subsp. *lucidus* Forel, Ann. Soc. Ent. Belg., Vol. 30, p. 200 (1886); Emery, Zool. Jahrb. Syst., Vol. 7, p. 666 (1893).

P. lucidus subsp. *montivagus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 419 (1915) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 156 (1947) ♀.

Type loc: Connecticut. Types: none in this country. Dr.. Smith believes that specimens at present in the Peabody Museum of Natural History are from the type series.

Range: eastern United States from New England to North Carolina and west to the Rocky Mountains.

Slaves: *F. nitidiventris, F. schaufussi.*

It is not surprising that Wheeler described *montivagus* as a subspecies of *lucidus*. The types of *montivagus* were taken near Manitou, Colorado, the most western record for *lucidus* to date. Unfortunately Wheeler was not aware that specimens which agree exactly with the types of *montivagus* occur in the eastern states. I have a long series of workers taken by Dr. H. T. Spieth at Lakehurst, New Jersey, which cannot be distinguished in any way from the types of *montivagus*. It would further appear that the principal difference between *montivagus* and *lucidus* lies in the lighter color of the first insect. The differences in pilosity which Wheeler used to separate *montivagus* are not reliable. As Dr. Smith has noted, erect hairs occur on the occipital lobes of some of the cotypes of *montivagus*. I cannot see that the number of these hairs, or of those on the gula, is significantly different from what one frequently finds in the darker eastern specimens attributed to *lucidus*. The occipital and gular hairs of this insect vary in number and I fail to see how this character can be successfully employed to separate *montivagus*. Since *montivagus* seems to be nothing more than a color variant which occurs over the whole range of *lucidus*, I have treated it as a synonym of that species.

2. Polyergus lucidus longicornis M. R. Smith

P. lucidus subsp. *longicornis* M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 155 (1947) ♀.

Type loc: Florence, South Carolina. Types: U.S.N.M.

Range: known only from type material.

The exact status of this variant cannot be determined until more material is available. It may, as Dr. Smith believes, be a southern race of *lucidus*. From what has just been said about *montivagus* it should be clear that it is risky to generalize about the range of such variants with no more than a single record as a basis. Since the typical *lucidus* occurs as far south as the Carolinas, it seems unlikely that *longicornis* could have a very extensive northward range. I am not inclined to attach much significance to the scape length of *longicornis*. Both Dr. Smith and I have been at some pains to point out that the scape length of the typical *lucidus* varies notably.

3. Polyergus rufescens bicolor Wasmann

P. bicolor Wasmann, Allg. Zeitschr. Ent. Neud, Vol. 6, No. 24 (1901) ♀ ♀ ♂.

P. rufescens subsp. *bicolor* Wasmann, Gesellshaftsleben d. Ameisen, Vol. 1, p. 278, pl. 3, figs. 3–8 (1915) ♀ ♀ ♂; M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 159 (1947) ♀.

Type loc: Prairie du Chien, Wisconsin. Types: none in this country. The specimens collected by Muckermann and marked as cotypes in various collections in this country, while authentic, are probably not types. Muckermann sent half of the material which he collected to Wasmann and half to Wheeler. The 'types' in American collections appear to belong to this second lot of material.

Range: Black Hills of South Dakota east to Illinois and Michigan. Smith has recorded this form from Flathead Lake, Montana, but I believe that this record applies to *breviceps*.

Slaves: *F. fusca*, *F. neorufibarbis*.

I have retained *bicolor* as an eastern race of *rufescens* although I am aware that it is often difficult to separate *bicolor* from *breviceps*. There seems to be nothing except color by which the two races may be distinguished. With fresh specimens the distinction is well-marked. But old specimens of *bicolor* tend to fade badly and are often impossible to separate from *breviceps*. I believe that this accounts for many of the eastern records which have been attributed to *breviceps*. The two races overlap in a region extending from eastern Colorado to Manitoba. Wheeler's *fusciventris* is one of the intergrades produced in this area.

4. Polyergus rufescens breviceps Emery

P. rufescens subsp. *breviceps* Emery, Zool. Jahrb. Syst., Vol. 7, p. 666 (1893) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 157 (1947) ♀.

P. rufescens subsp. *breviceps* var. *silvestrii* Santschi, Bull. Soc. Ent. Ital., Vol. 41, p. 7 (1909) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 161 (1947) ♀.

P. rufescens subsp. *breviceps* var. *montezuma* Wheeler, Jour. N. Y. Ent. Soc., Vol. 22, p. 56 (1914) ♀ ♀ ♂.

P. rufescens subsp. *breviceps* var. *fusciventris* Wheeler, Proc. Amer. Acad. Arts. Sci. Boston, Vol. 52, p. 555 (1917) ♀ ; M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 161 (1947) ♀ .

Type loc: Breckenridge, Colorado (by present restriction). Types: none in this country.

Range: Rocky Mountain Region from New Mexico to Montana and northwestward to Washington. The insect also occurs sporadically in the mountains of Utah, California and Arizona.

Slaves: *F. fusca*, *F. montana.*

There has been considerable synonymy necessary in the case of *breviceps*. I have treated Santschi's variety *silvestrii* as a synonym of *breviceps*, although the form is, at best, doubtfully recognizable without a reference to the type. But it seems clear enough that Santschi did not have specimens of *umbratus* or *laeviceps* for he used the marked occipital impression of *silvestrii* as the main means for separation. Since this feature is more commonly met with in *breviceps* than in either of the other two forms, we may surmise that what Santschi had was the typical *breviceps*. I have already shown the futility of trying to estimate the value of characteristics in Polyergus from a limited series of specimens. It is not surprising, therefore, that Santschi found a difference when he compared the material of *silvestrii* with the single type of *breviceps* which Forel had sent him. Wheeler's *fusciventris* has already been mentioned as an intergrade between *breviceps* and *bicolor*. As a matter of fact it was described as such. Wheeler's *montezuma* is included here only because this variant occurs at high elevations in the Huachuca Mountains of Arizona. As may be recalled, Wheeler described *montezuma* from a small series of specimens which Mann took in Pachuca, Mexico. In 1932 the writer took many specimens of this ant at an elevation of 9000 feet in Ramsey Canyon. Examination of these specimens has convinced me that there is no essential difference between *montezuma* and the typical *breviceps*. The color of *montezuma* is a trifle darker in some specimens and there is a tendency for the cephalic sculpture to be less dense. But both features are well within the range of variation shown by *breviceps* and I see no way in which *montezuma* can be satisfactorily separated.

5. Polyergus rufescens laeviceps Wheeler

P. rufescens subsp. *laeviceps* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 420 (1915) ♀ ; M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 160 (1947) ♀ .

Type loc: Mt. Tamalpais, San Francisco, California. Types: A.M.N.H., M.C.Z., U.S.N.M., Coll. W. S. Creighton.
Range: known from central California only.
Slaves: *F. fusca, F. subpolita.*

The status of *laeviceps* cannot be exactly determined until more is known of the range of this form. It seems likely that it replaces *breviceps* in the coastal area in California. On the other hand, it is well to bear in mind that the smooth and shining surface of *laeviceps* may not, after all, serve to separate it from *breviceps.* A considerable part of the material from Lake Tahoe which Wheeler regarded as *breviceps* could, in my opinion, be assigned to *laeviceps* with equal propriety. At present we know far too little about the distribution of the forms of *rufescens* in California. It is entirely possible that when the situation is better known further changes will have to be made in the treatment of this material.

6. Polyergus rufescens umbratus Wheeler

P. rufescens subsp. *breviceps* var. *umbratus* Wheeler, Bull. Amer. Mus. Nat. Hist., Vol. 34, p. 419 (1915) ♀; M. R. Smith, Amer. Mid. Naturalist, Vol. 38, No. 1, p. 160 (1947) ♀.
Type loc: Brookdale, California. Types: A.M.N.H., M.C.Z., U.S.N.M., Coll. W. S. Creighton.
Range: California east through the mountains of Nevada and Utah.
Slave: *F. fusca.*

This very distinct form is certainly of more than varietal rank. The color difference noted by Wheeler is not, in my opinion, the significant feature of *umbratus.* Some of the specimens are almost as light in color as *breviceps.* But the head of *umbratus* is more rectangular than that of any other form of *rufescens.* Moreover, there seems to be remarkably little variation in the shape of the head. The cephalic sculpture of *umbratus* is feebler than that ordinarily encountered in *breviceps,* so that its head is a little more shining although not so strongly as is the case with *laeviceps.* The female of *umbratus* is quite small. Its length varies from 7.5–8.5 mm. As far as I have been able to judge, *umbratus* is the only form of *rufescens* present in the mountains of Nevada and Utah. All the nests which I have seen have been situated on open slopes where sage brush is present. The nests are built in very dry and rocky soil. I have never taken the insect at elevations lower than 7000 feet.

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PLATES

Unless otherwise noted, all the figures on a plate are drawn to the same scale.

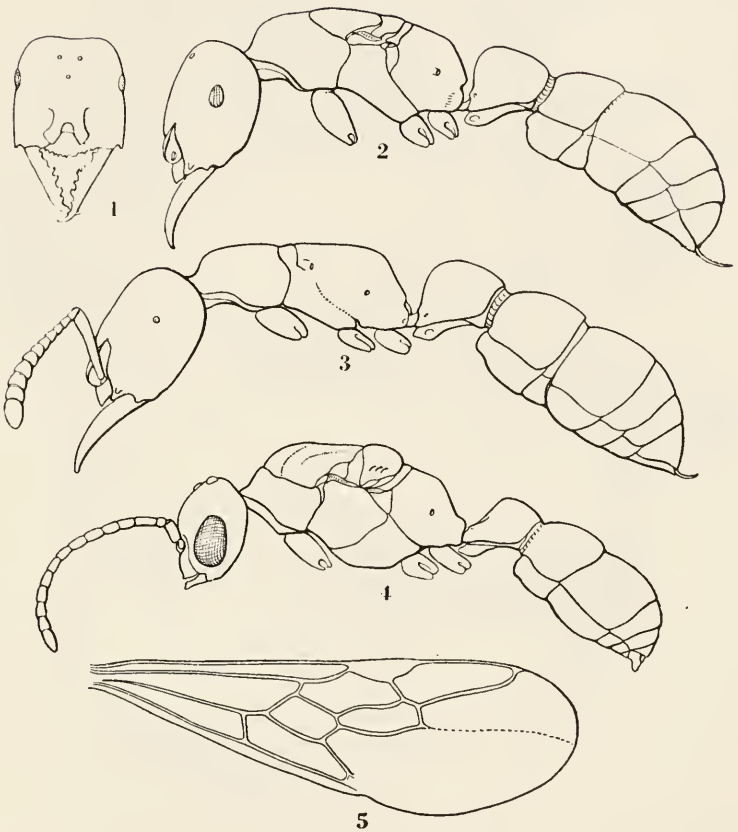


PLATE 1

Stigmatomma pallipes Haldeman

1. Head of female. 2. Female. 3. Worker. 4. Male. 5. Wing.

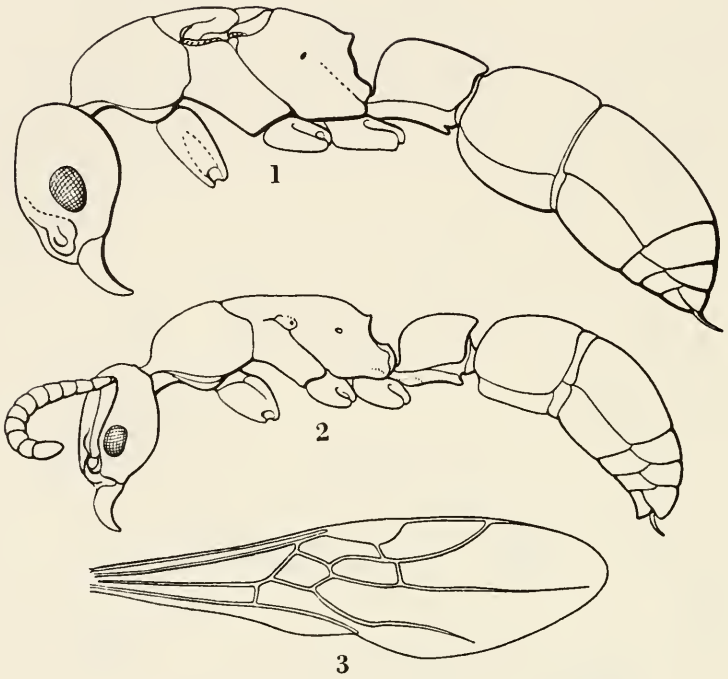


PLATE 2

Platythyrea punctata F. Smith

1. Female. 2. Worker. 3. Wing.

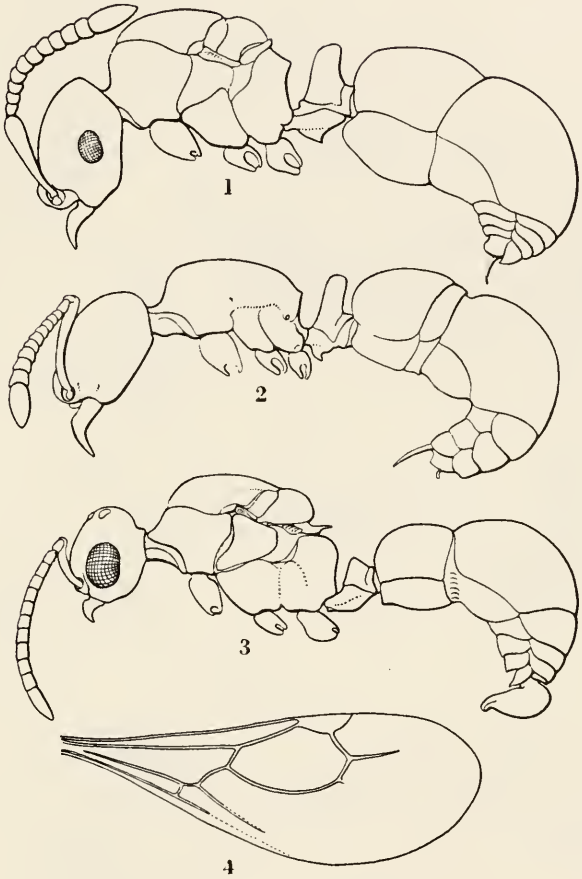


PLATE 3

Proceratium silaceum Roger

1. Female. 2. Worker. 3. Male. 4. Wing.

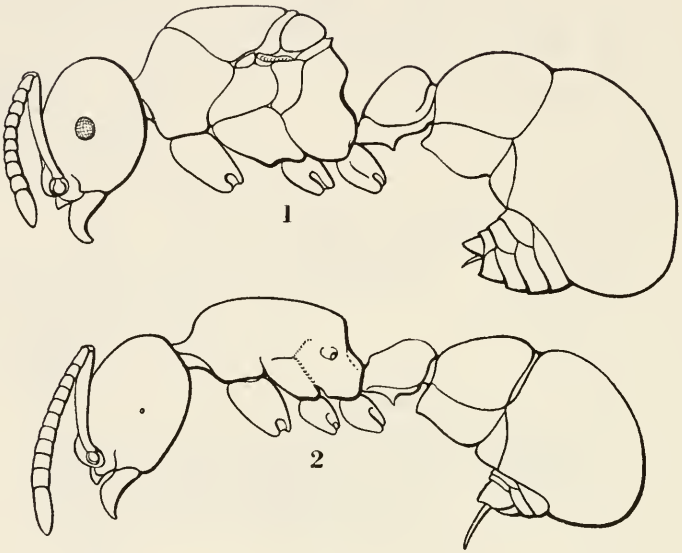


PLATE 4

Sysphincta pergandei Emery

1. Female. 2. Worker.

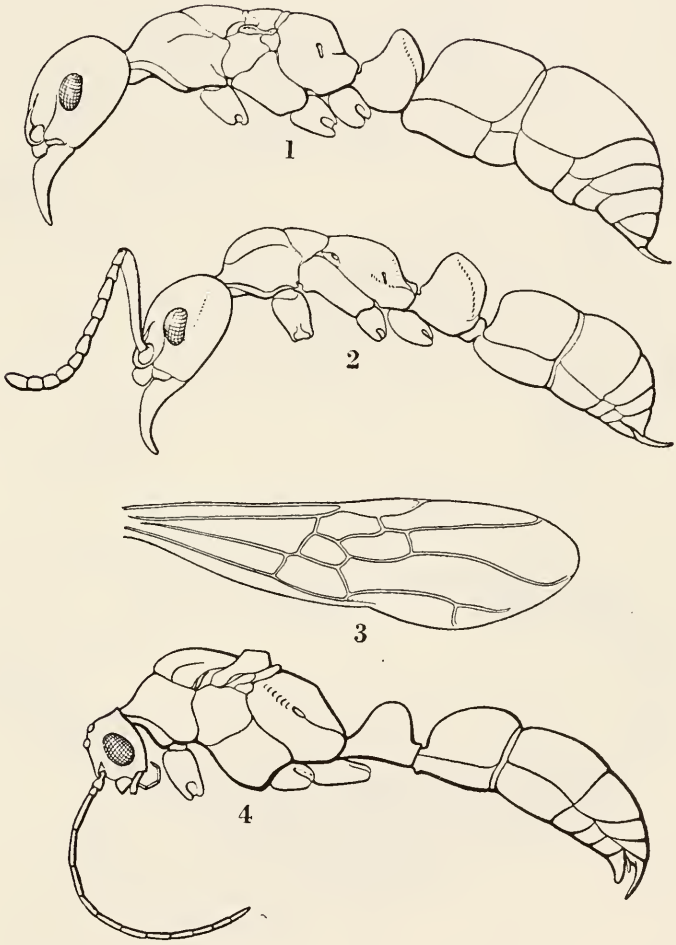


PLATE 5

Neoponera villosa Fabricius

1. Female. 2. Worker. 3. Wing. 4. Male.

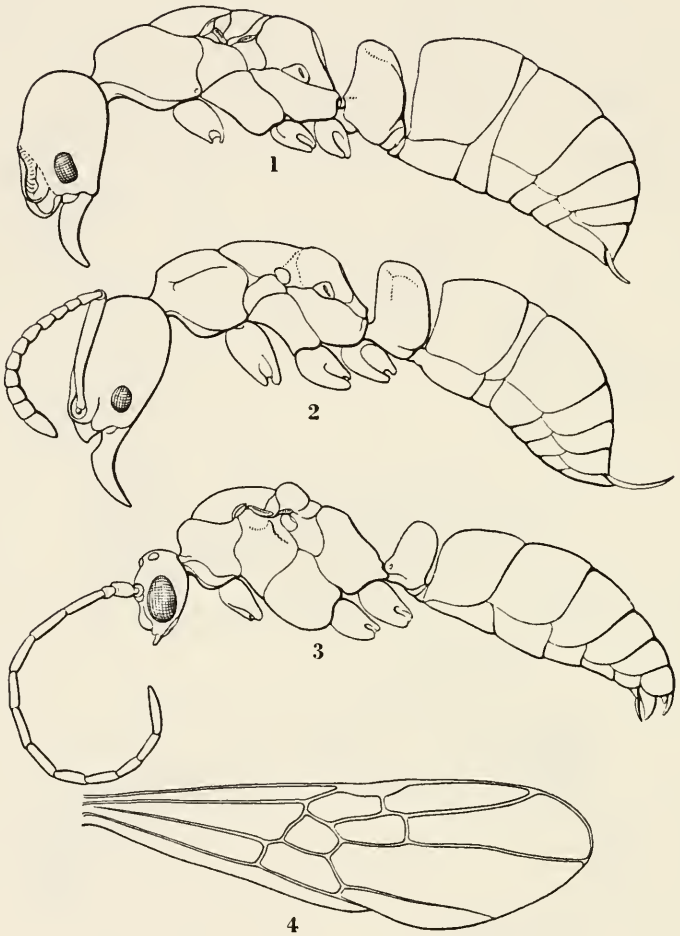


PLATE 6

Pachycondyla harpax subsp. *montezumia* F. Smith

1. Female. 2. Worker. 3. Male. 4. Wing.

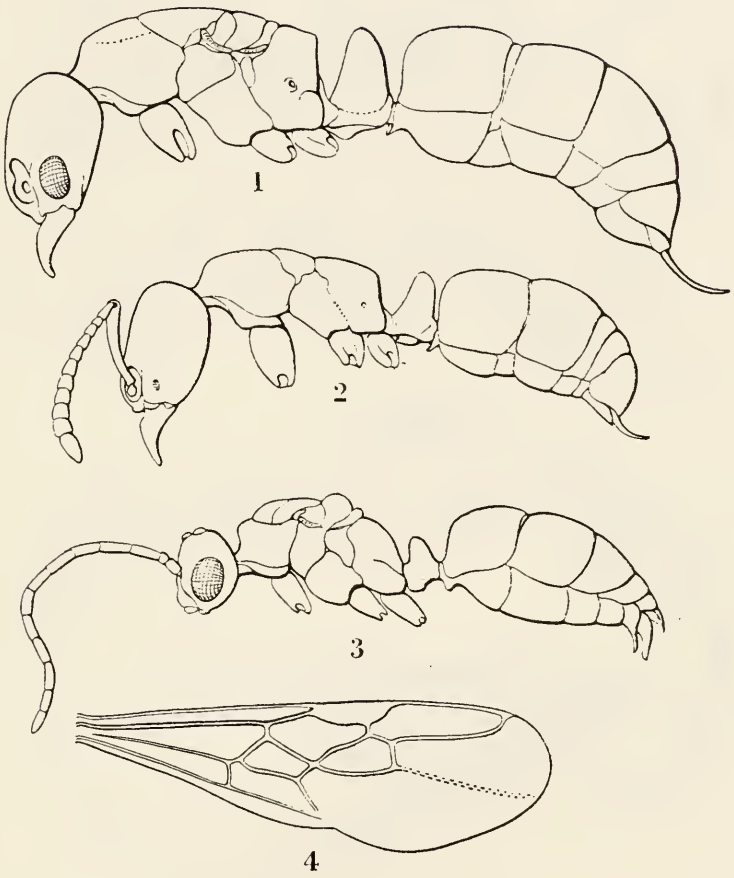


PLATE 7

Euponera (*Trachymesopus*) *stigma* Fabricius

1. Female. 2. Worker. 3. Male. 4. Wing.

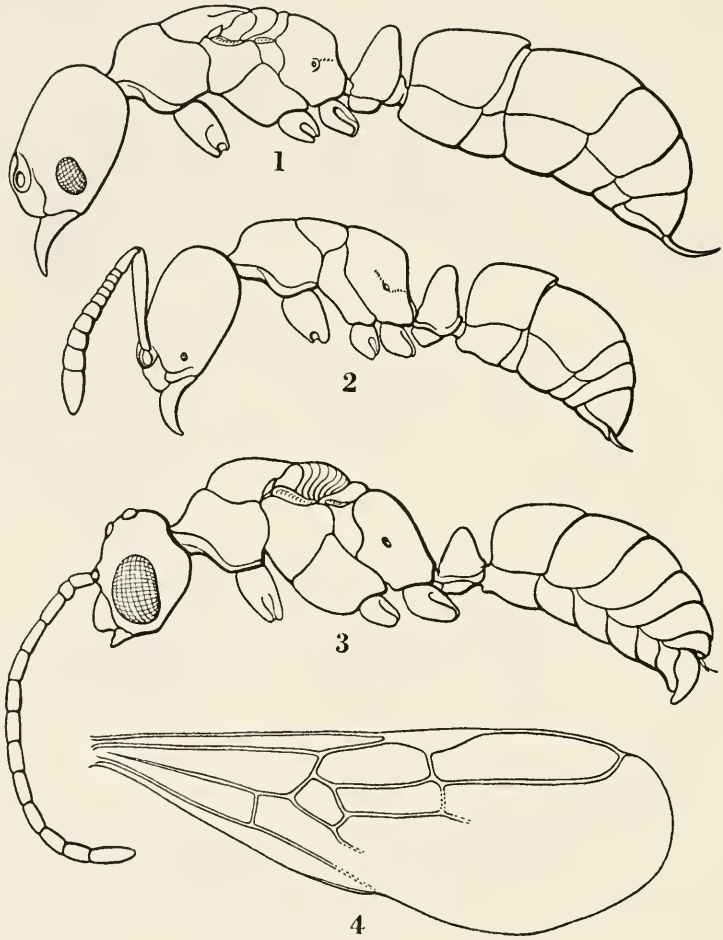


PLATE 8

Ponera trigona subsp. *opacior* Forel

1. Female. 2. Worker. 3. Male. 4. Wing.

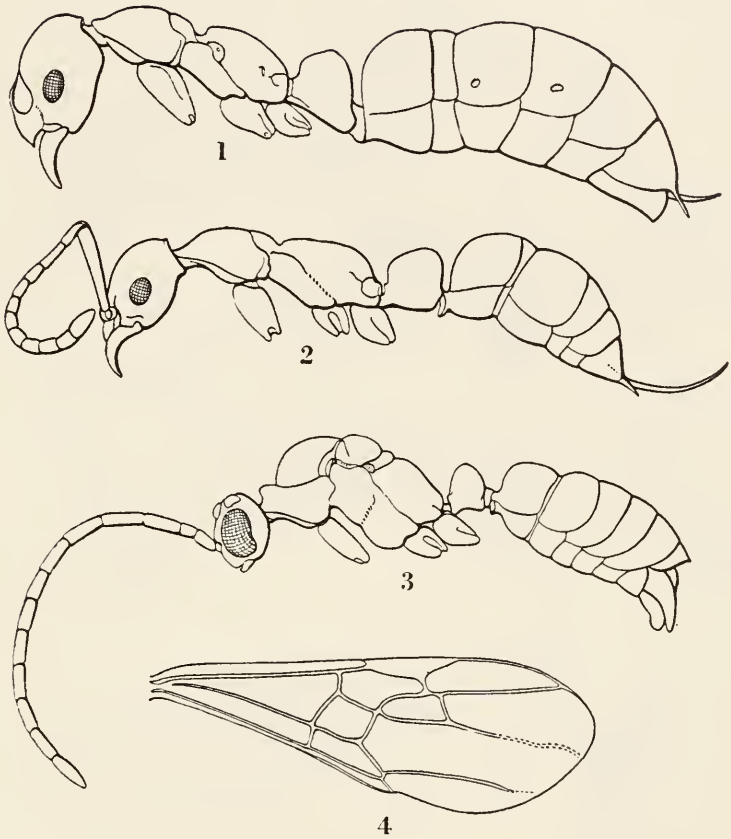


PLATE 9

Leptogenus (*Lobopelta*) *elongata* Buckley

1. Ergatogyne. 2. Worker. 3. Male. 4. Wing.

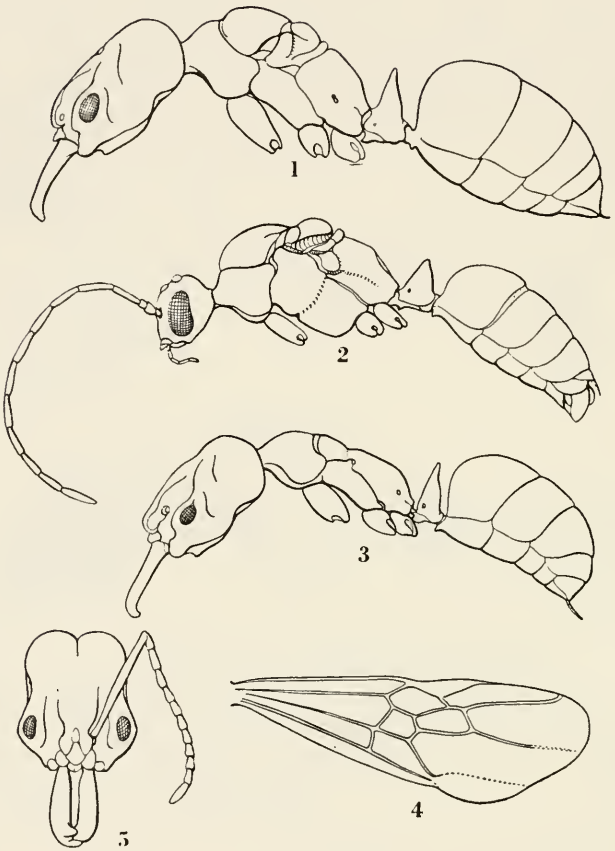


PLATE **10**

Odontomachus haematoda subsp. *Clarus* Roger

1. Female. 2. Male. 3. Worker. 4. Wing. 5. Head of worker.

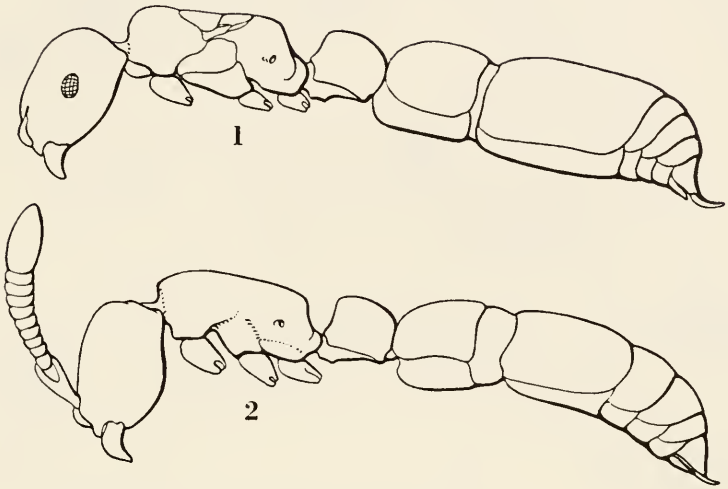


PLATE 11

Cerapachys (*Parasyscia*) *augustae* Wheeler

1. Female. 2. Worker.

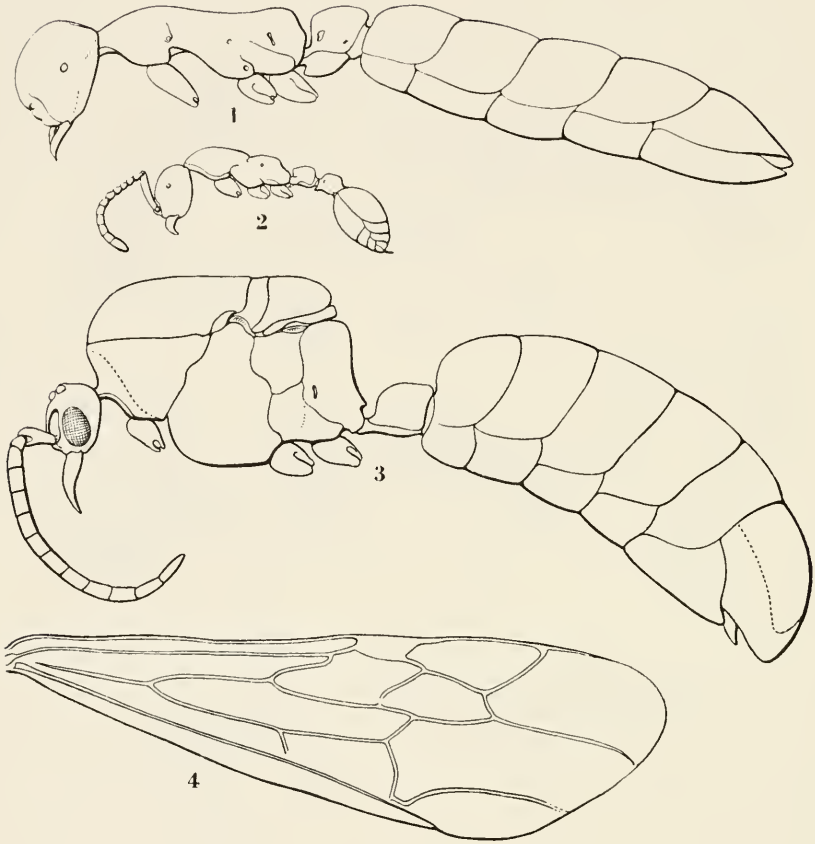


PLATE **12**

Eciton (*Neivamyrmex*) *nigrescens* Cresson

1. Dichthadiigyne. 2. Worker. 3. Male. 4. Wing.

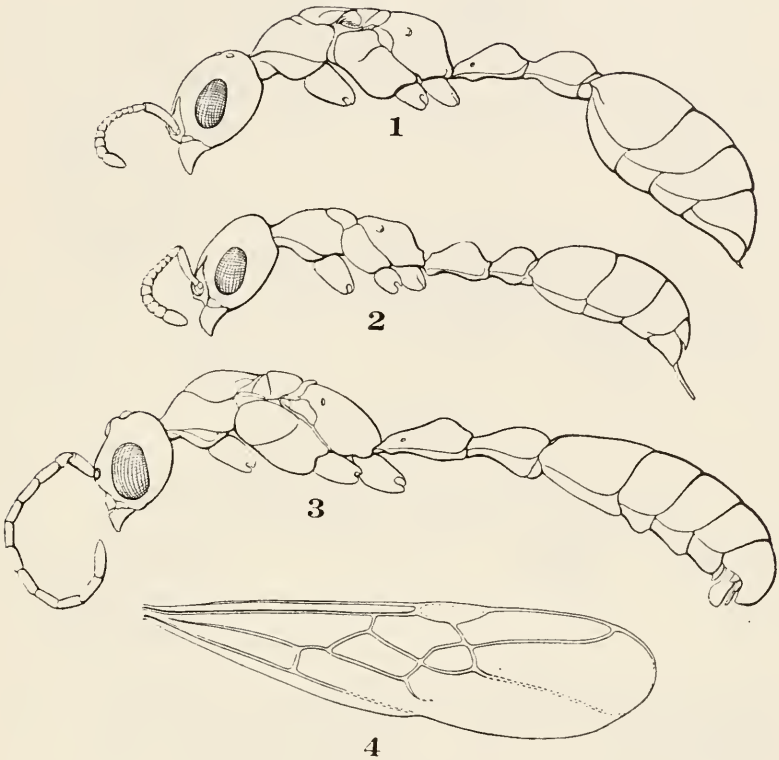


PLATE 13

Pseudomyrma pallida F. Smith

1. Female. 2. Worker. 3. Male. 4. Wing.

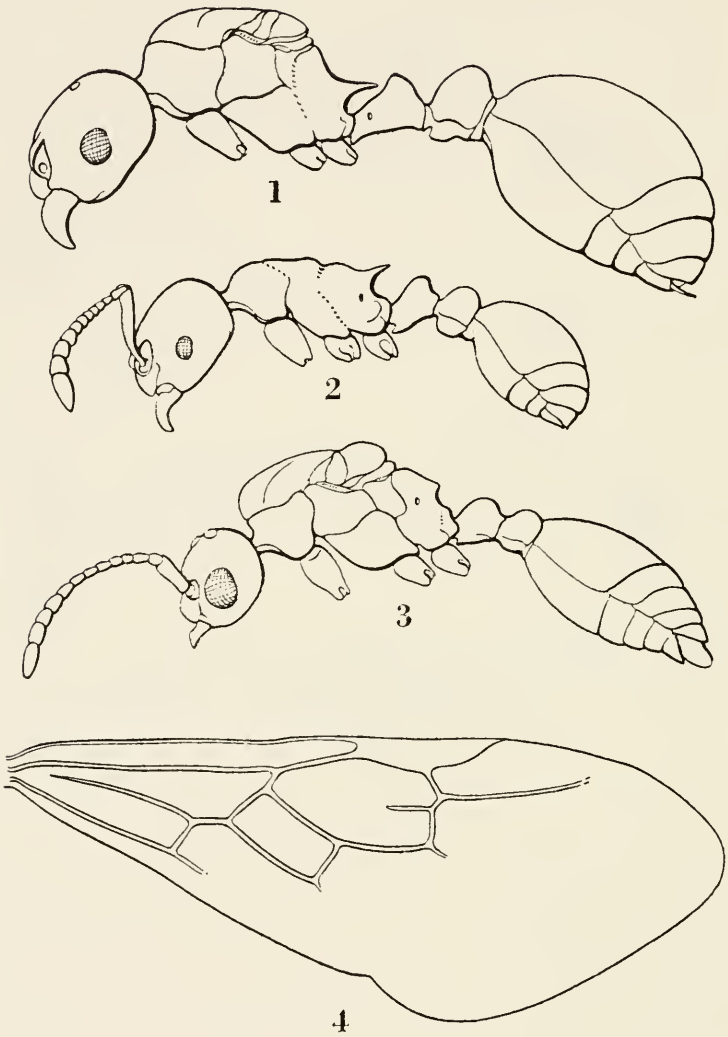


PLATE 14

Myrmica brevinodis Emery

1. Female. 2. Worker. 3. Male. 4. Wing

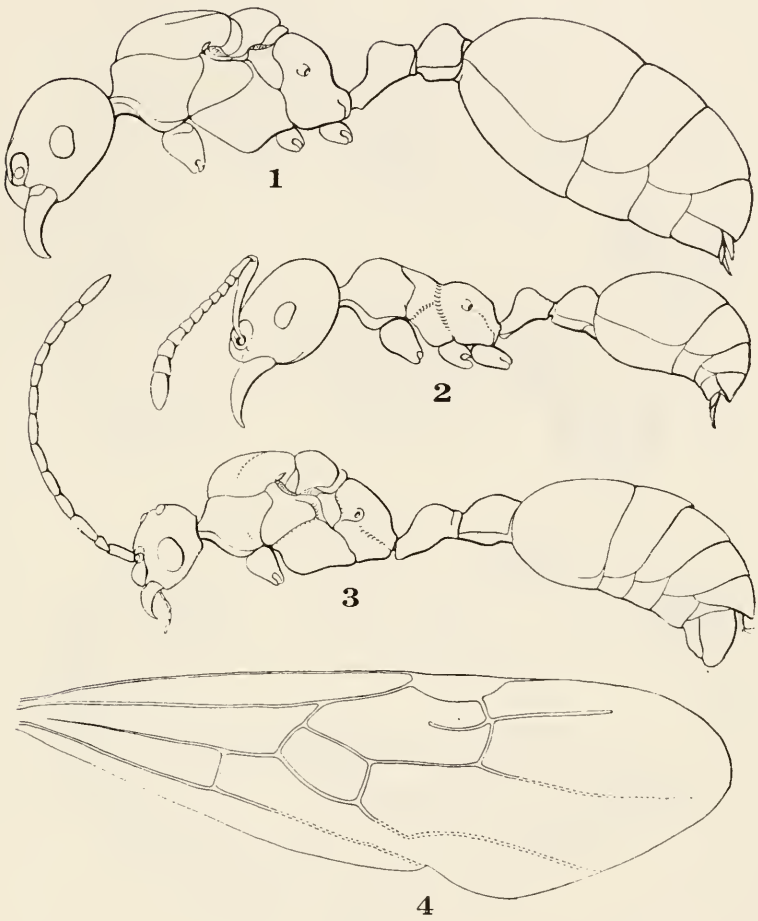


PLATE 15

Manica mutica Emery

1. Female. 2. Worker. 3. Male. 4. Wing.

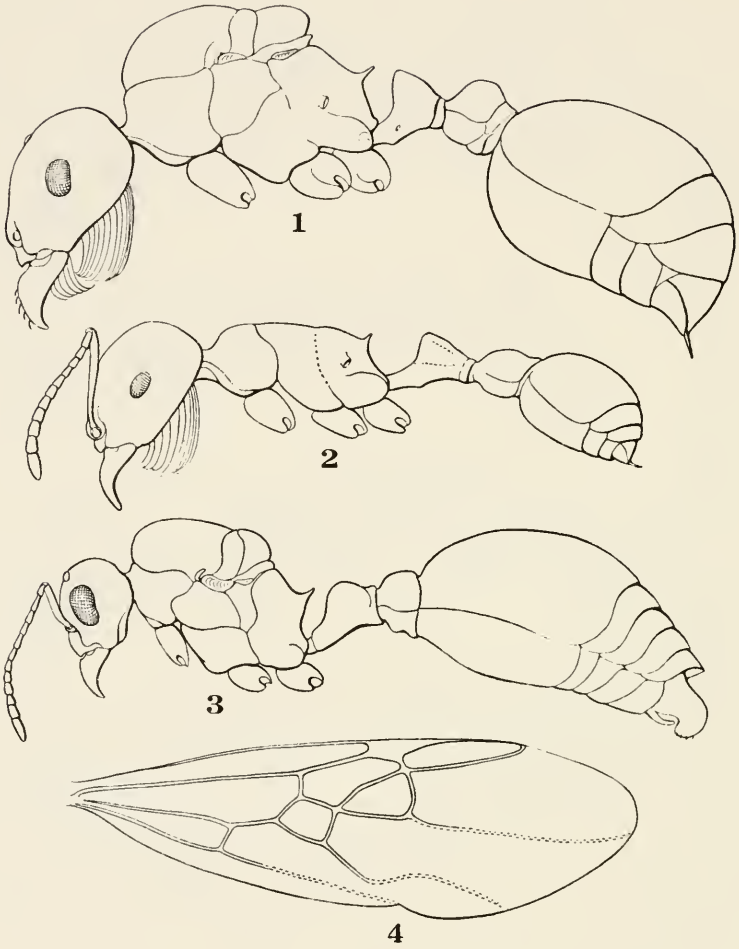


PLATE 16

Pogonomyrmex occidentalis subsp. *comanche* Wheeler

1. Female. 2. Worker. 3. Male. 4. Wing.

Male and Female drawn from specimens which Wheeler associated with *comanche*, see text, p. 129.

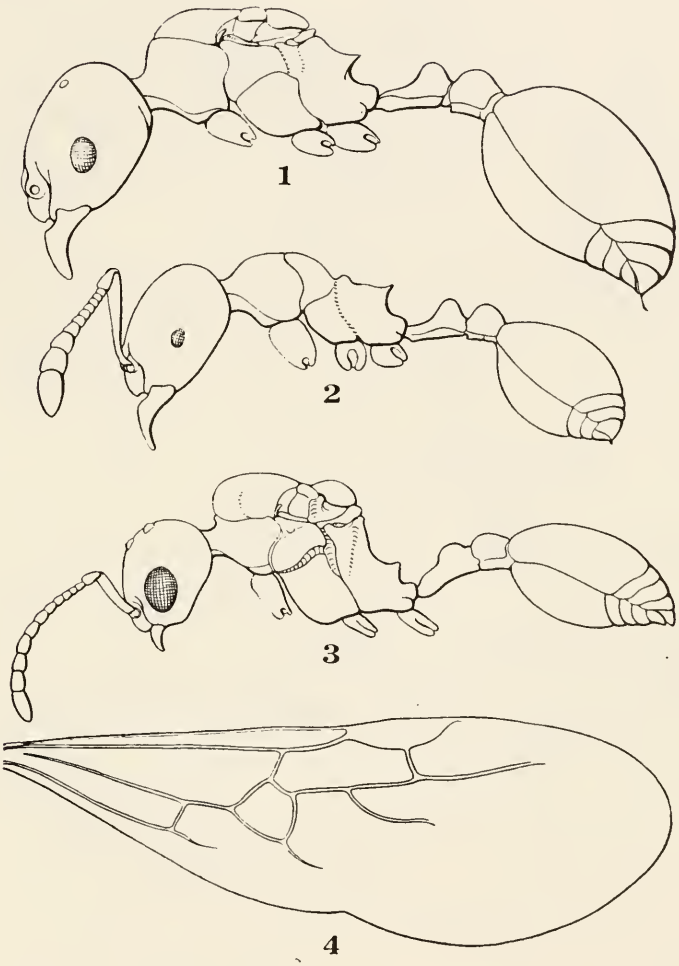


PLATE 17

Stenamma brevicorne Mayr

1. Female. 2. Worker. 3. Male. 4. Wing.

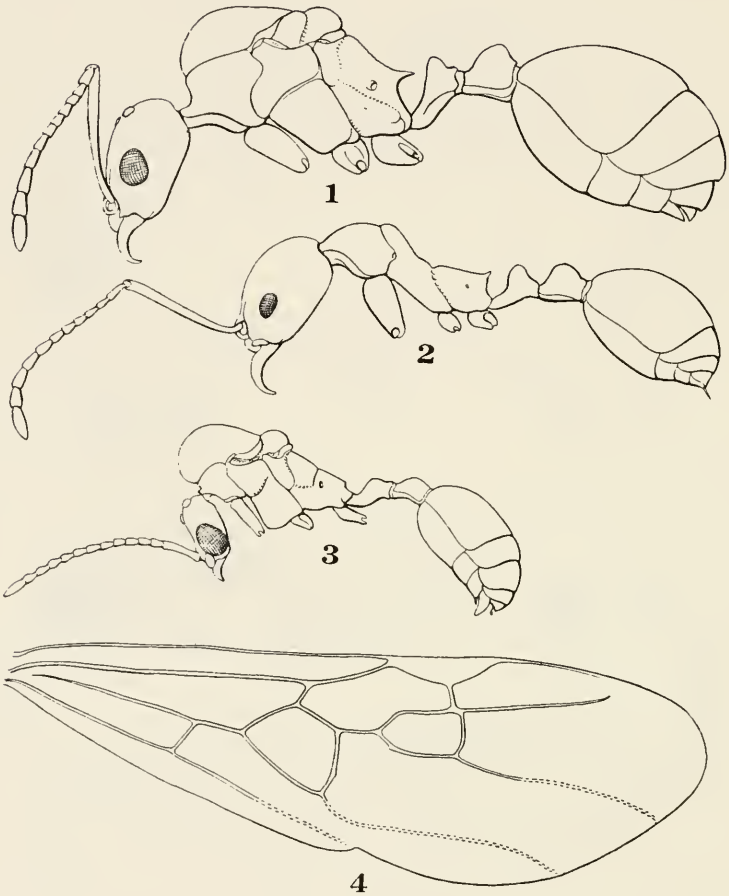


PLATE 18

Aphaenogaster (*Attomyrma*) *texana* Emery

1. Female. 2. Worker. 3. Male. 4. Wing.

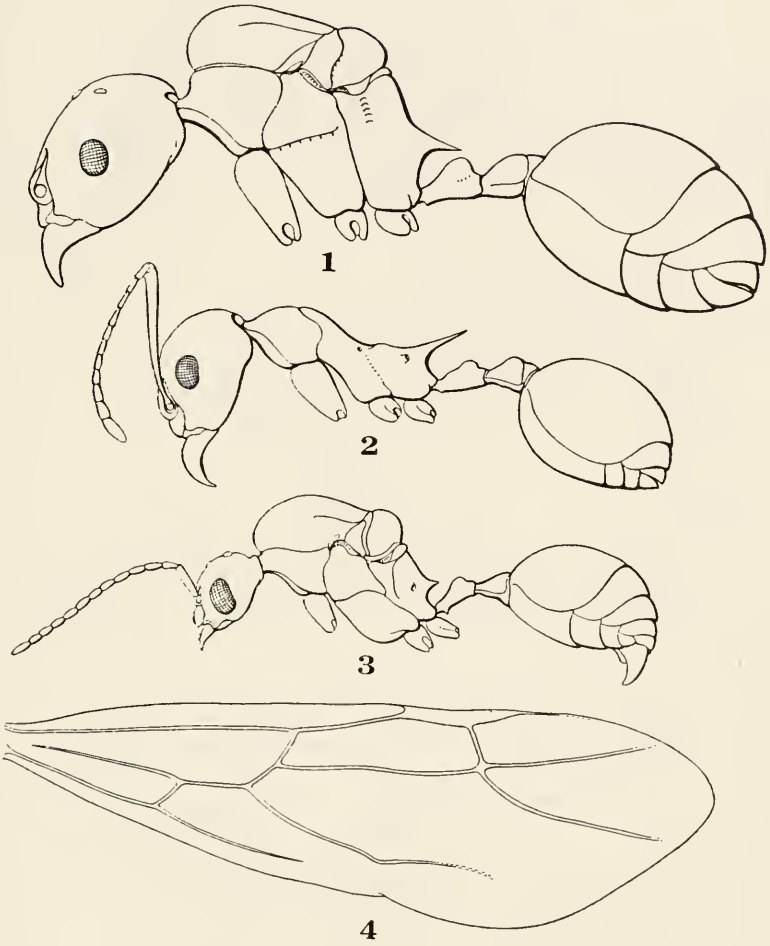


PLATE 19

Novomessor albisetosus MAYR

1. Female. 2. Worker. 3. Male. 4. Wing.

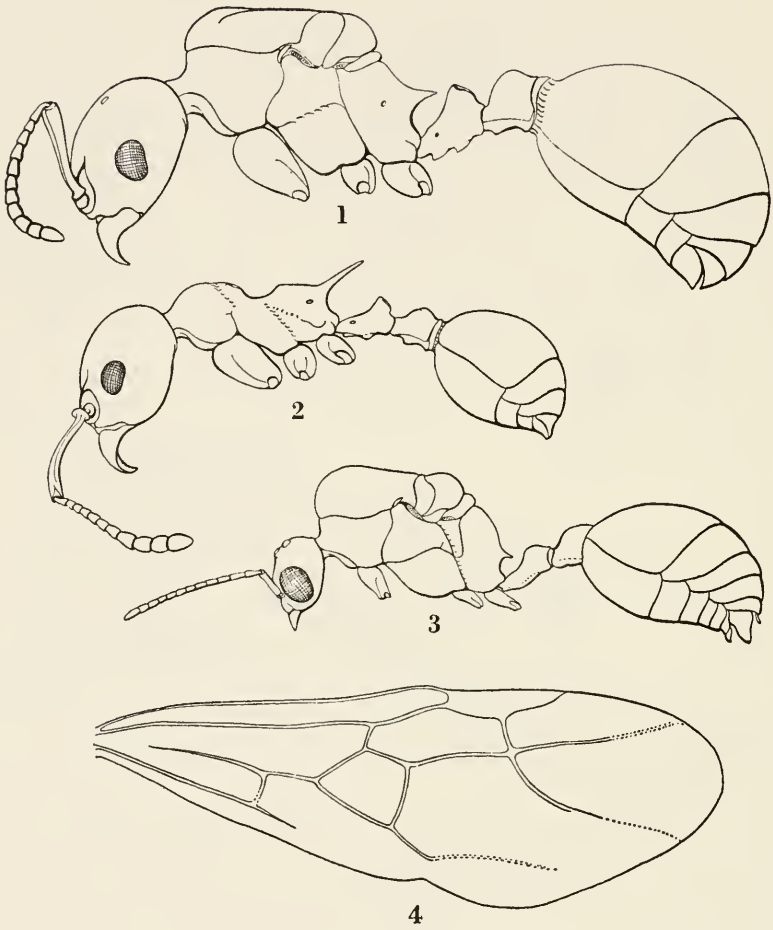


PLATE 20

Veromessor andrei Mayr

1. Female. 2. Worker. 3. Male. 4. Wing.

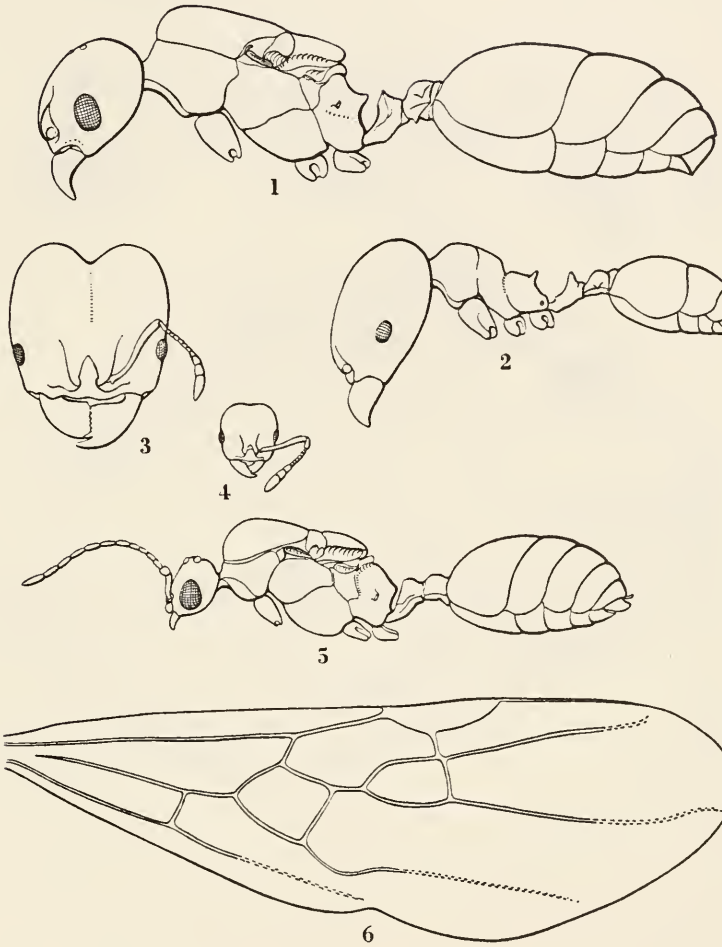


PLATE 21

Pheidole pilifera subsp. *pacifica* Wheeler

1. Female. 2. Worker. 3. Head of major. 4. Head of minor. 5. Male. 6. Wing.

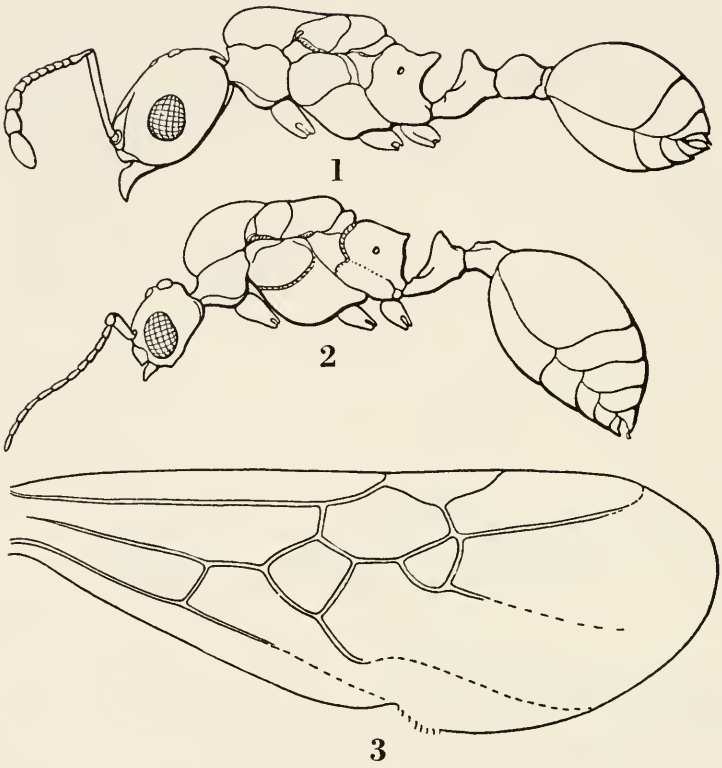


PLATE 22

Epipheidole inquilina Wheeler

1. Female. 2. Male. 3. Wing.

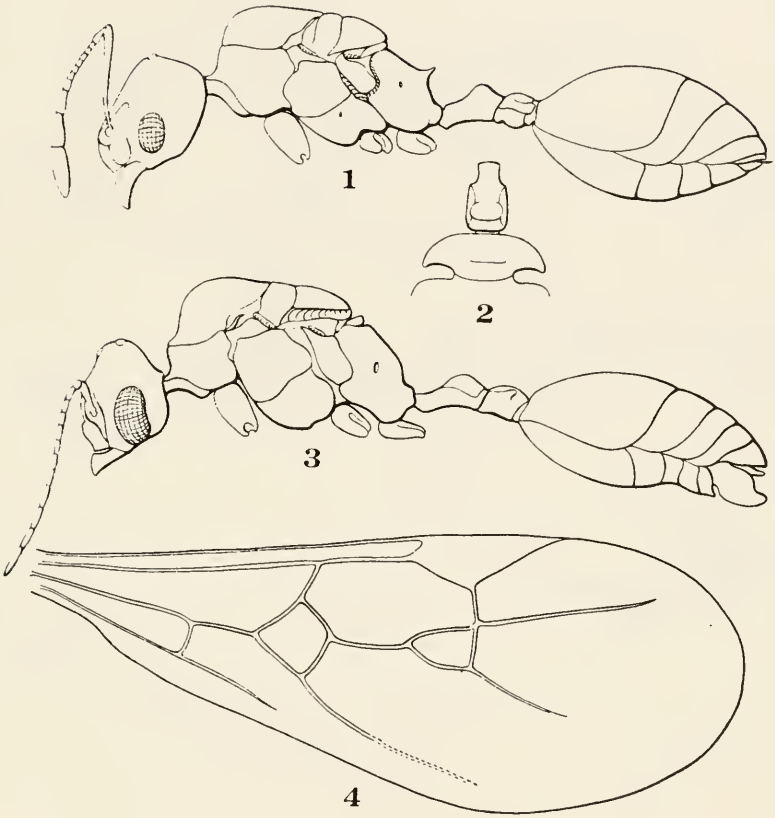


PLATE 23

Sympheidole elecebra Wheeler

1. Female. 2. Petiolar nodes of female from above. 3. Male. 4. Wing.

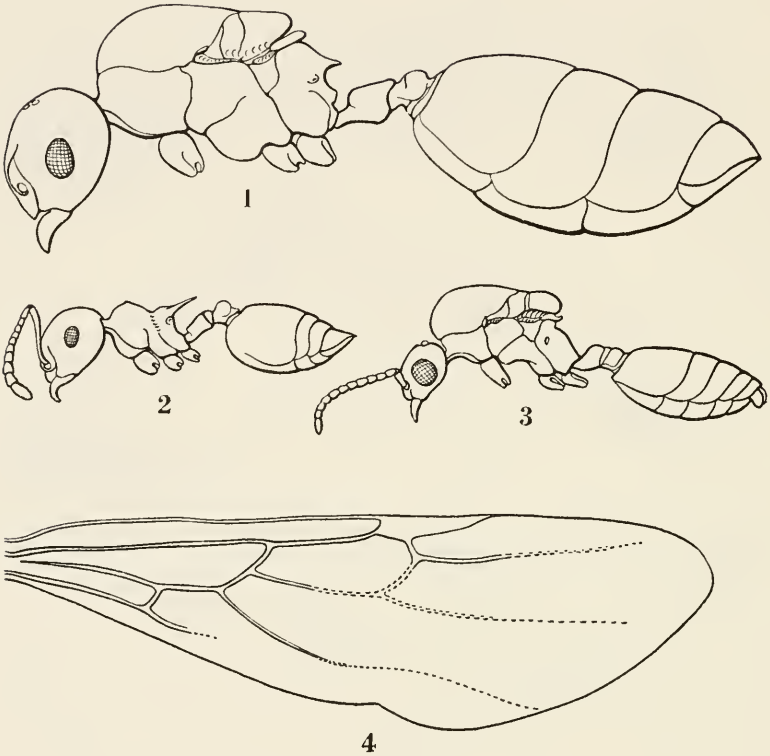


PLATE **24**

Crematogaster (*Acrocoelia*) *atkinsoni* Wheeler

1. Female. 2. Worker. 3. Male. 4. Wing.

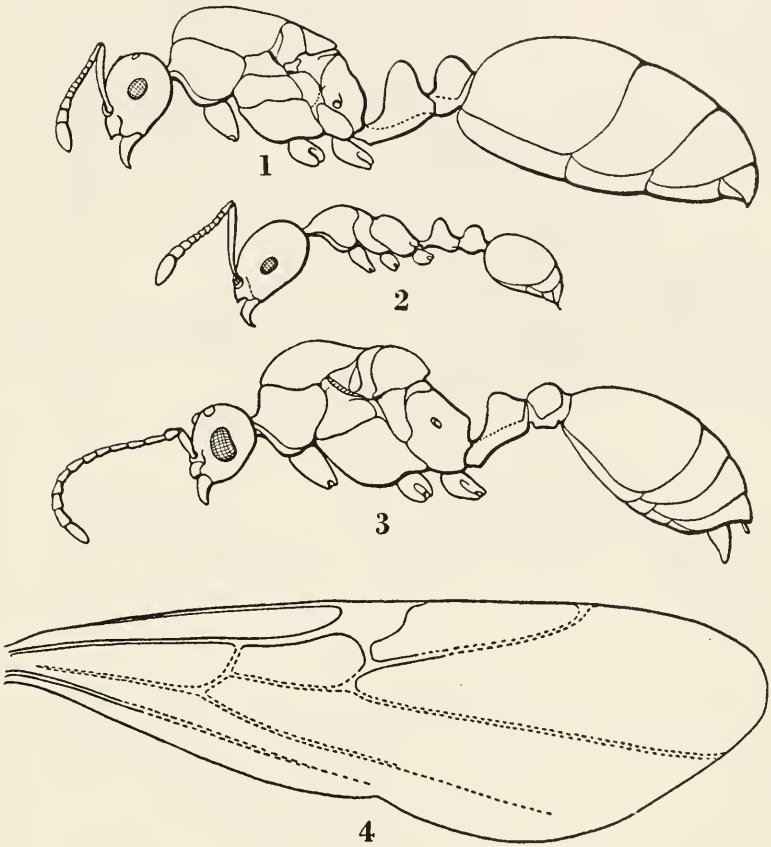


PLATE 25

Monomorium minimum Buckley

1. Female. 2. Worker. 3. Male. 4. Wing.

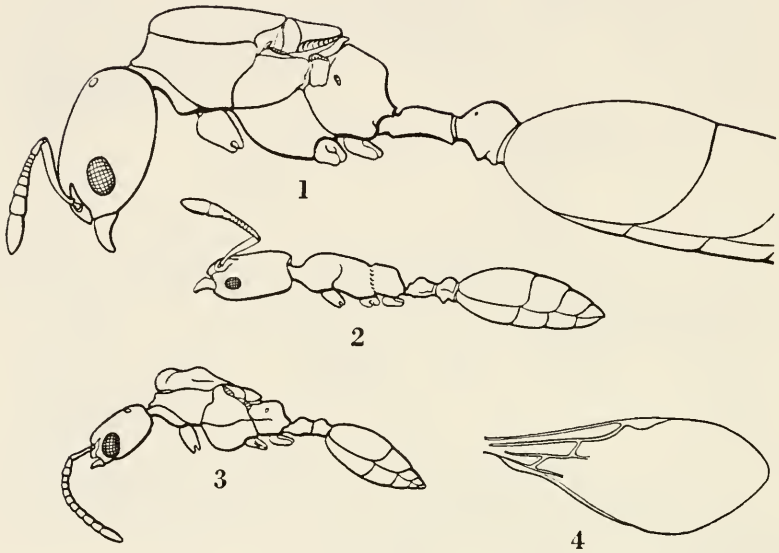


PLATE 26

Xenomyrmex stolli Forel

Xenomyrmex stolli subsp. *floridana* Emery; 1. Female. 2. Worker.
Xenomyrmex stolli subsp. *skwarrae* Wheeler; 3. Male. 4. Wing.

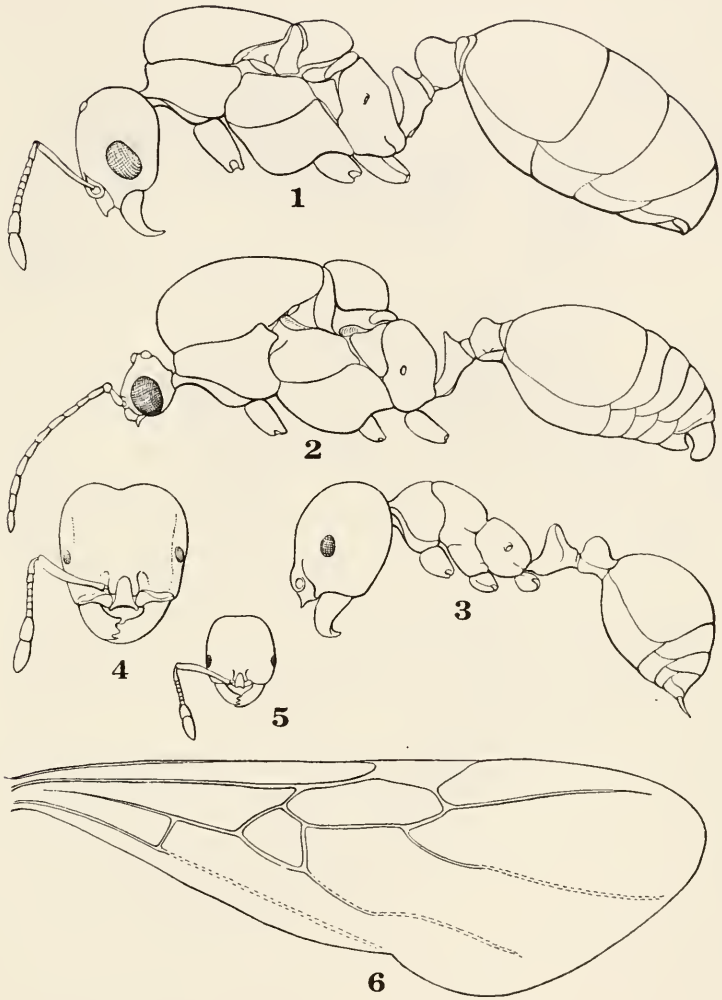
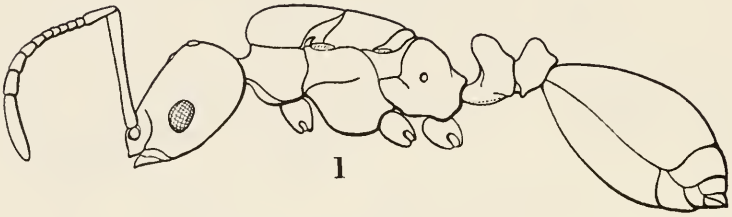


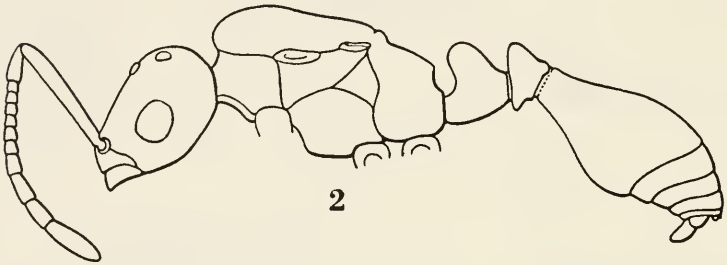
PLATE 27

Solenopsis aurea Wheeler

1. Female. 2. Male. 3. Worker. 4. Head of major. 5. Head of minor. 6. Wing.



1



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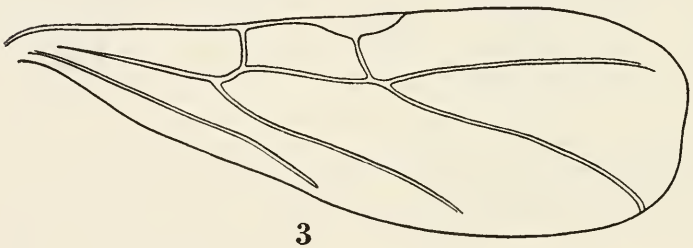


3

PLATE 28

Epoecus pergandei Emery

1. Female. 2. Male (after Emery). 3. Wing.

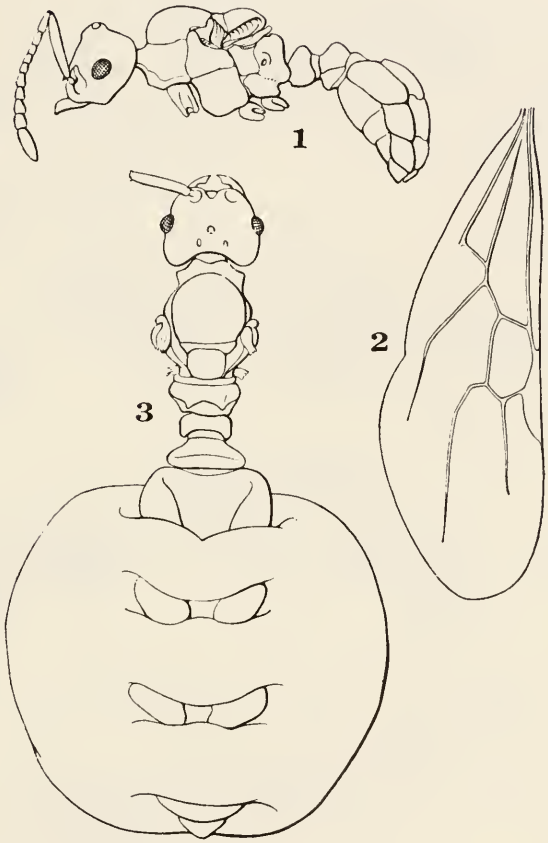


PLATE 29

Anergates atratulus Schenck

1. Virgin female. 2. Wing. 3. Fertile female.

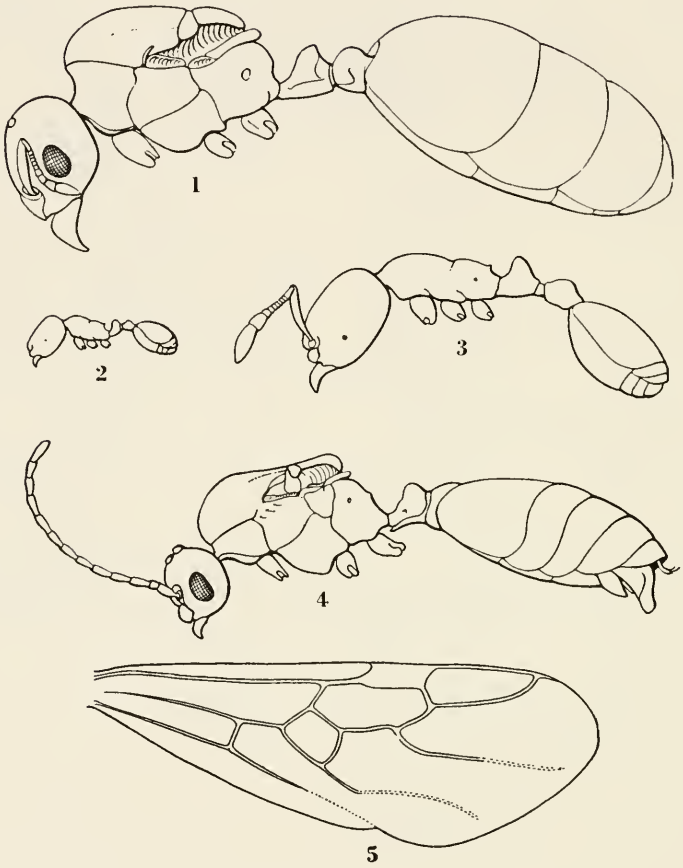


PLATE 30

Erebomyrma longi Wheeler

1. Female. 2. Worker drawn in scale with sexual forms.
3. Worker enlarged to show detail. 4. Male. 5. Wing.

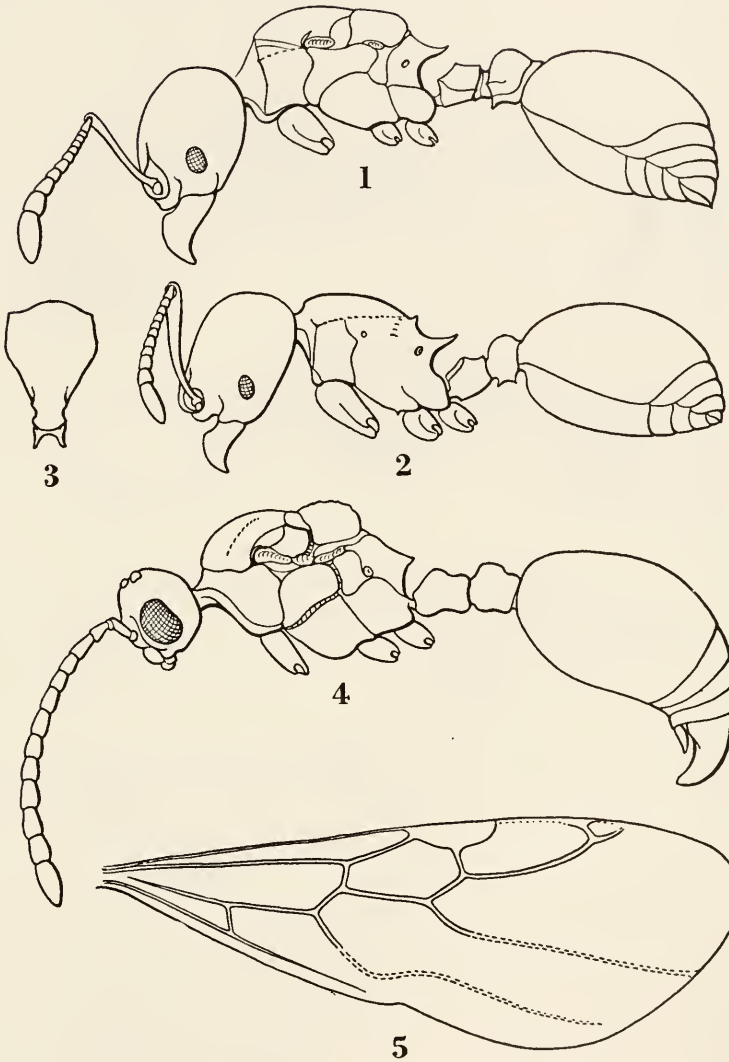
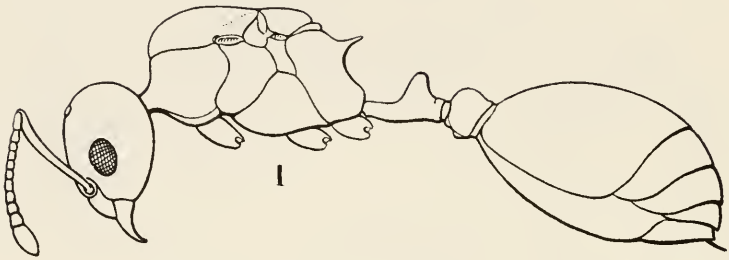


PLATE 31

Myrmecina americana Emery

1. Female. 2. Worker. 3. Thorax of worker from above. 4. Male. 5. Wing.



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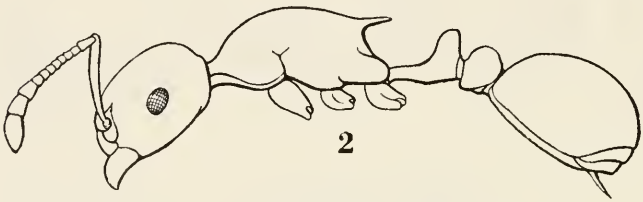

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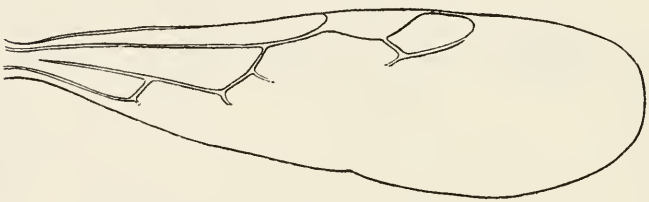


3

PLATE 32

Macromischa subditiva Wheeler

1. Female. 2. Worker. 3. Wing.

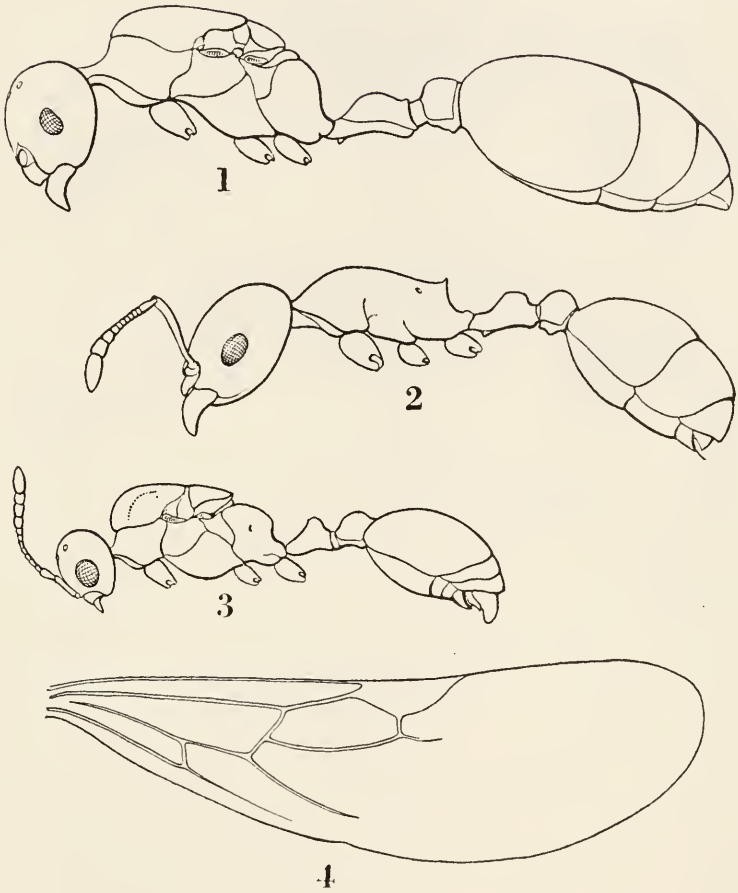


PLATE 33

Leptothorax obturator Wheeler

1. Female. 2. Worker. 3. Male. 4. Wing.

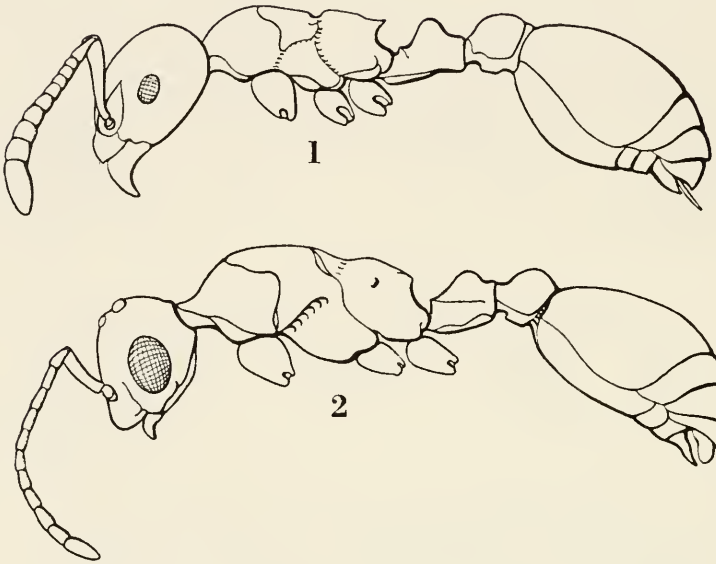


PLATE 34

Symmyrmica chamberlini Wheeler

1. Worker. 2. Ergatoid male.

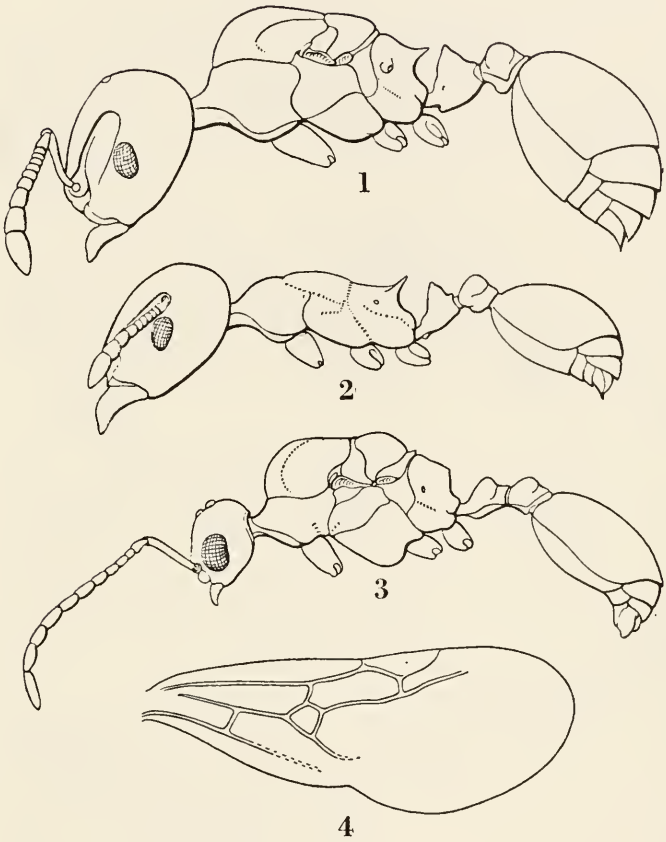


PLATE 35

Harpagoxenus americanus Emery

1. Female. 2. Worker. 3. Male. 4. Wing.

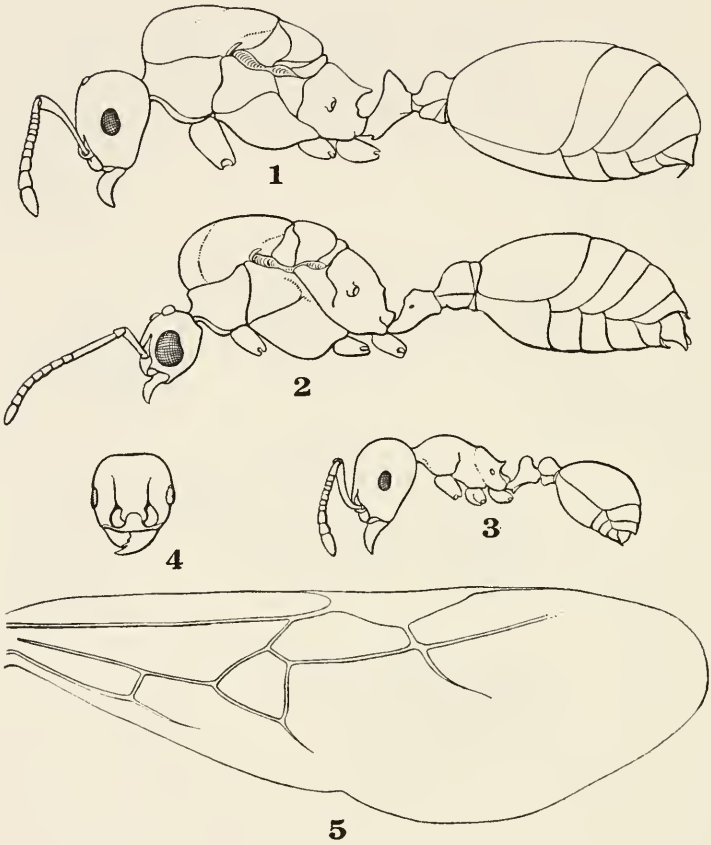


PLATE 36

Tetramorium caespitum Linné

1. Female. 2. Male. 3. Worker. 4. Head of worker from front. 5. Wing.

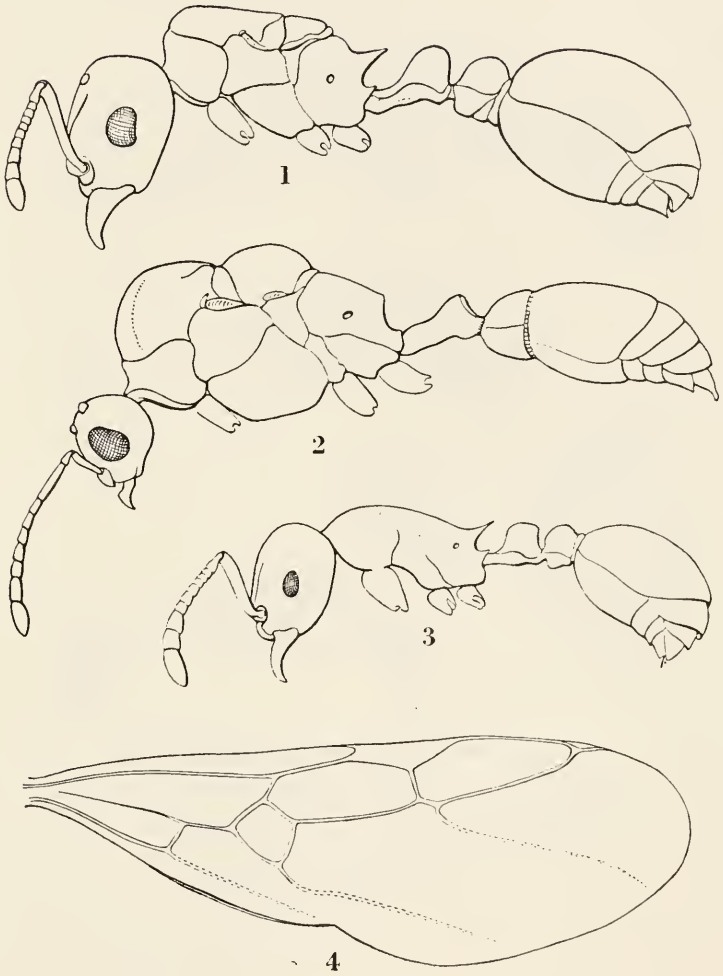


PLATE 37

Xiphomyrmex spinosus subsp. *insons* Wheeler

1. Female. 2. Male. 3. Worker. 4. Wing.

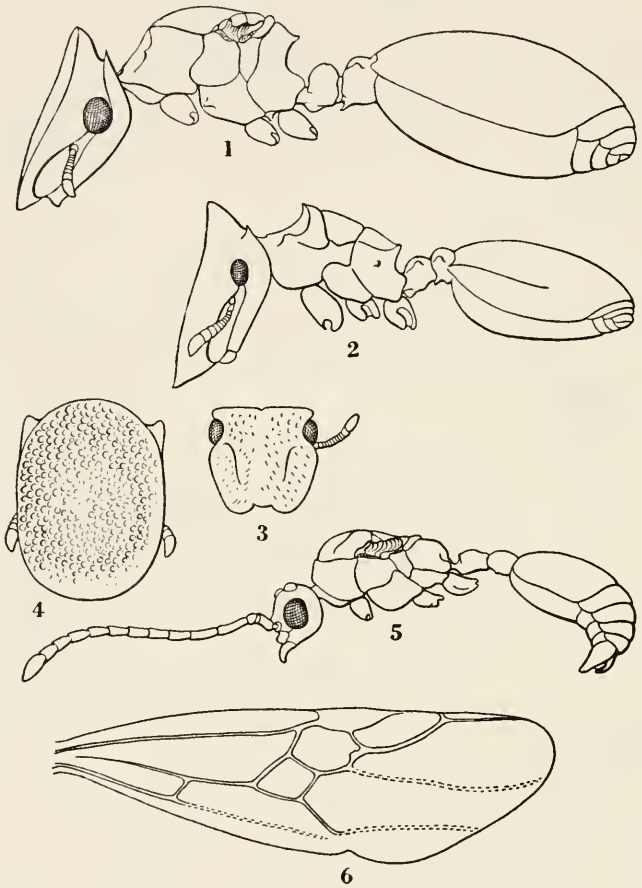


PLATE 38

Cryptocerus (*Cyathomyrmex*) *varians* F. Smith

1. Female. 2. Major worker. 3. Minor worker, top of head. 4. Major worker, top of head. 5. Male. 6. Wing.

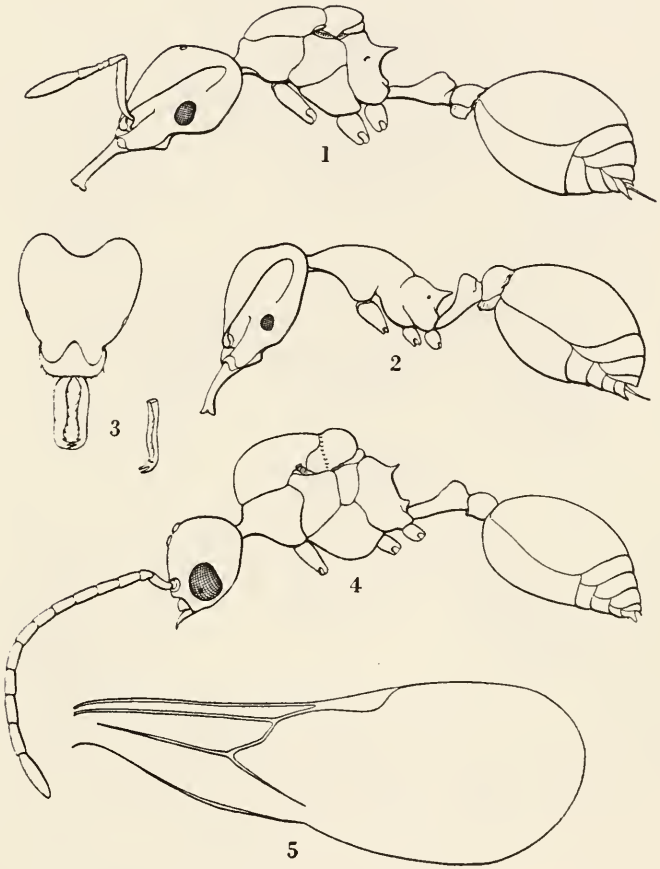


PLATE 39

Strumigenys louisianae Roger

1. Female. 2. Worker. 3. Head of worker from front, and mandible. 4. Male. 5. Wing.

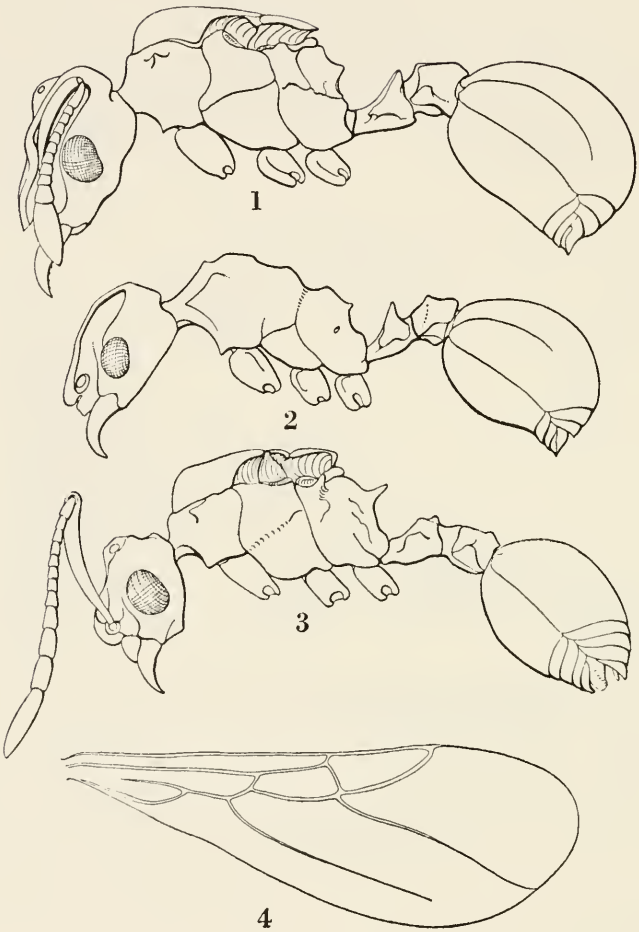


PLATE 40

Cyphomyrmex wheeleri Forel

1. Female. 2. Worker. 3. Male. 4. Wing, drawn to smaller scale.

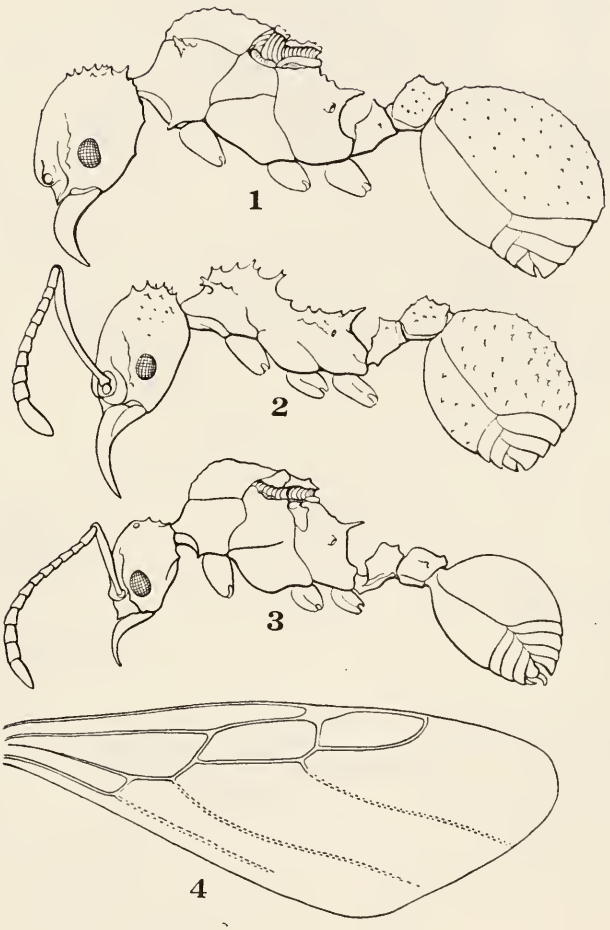


PLATE 41

Trachymyrmex septentrionalis subsp. *obscurior* Wheeler

1. Female. 2. Worker. 3. Male. 4. Wing.

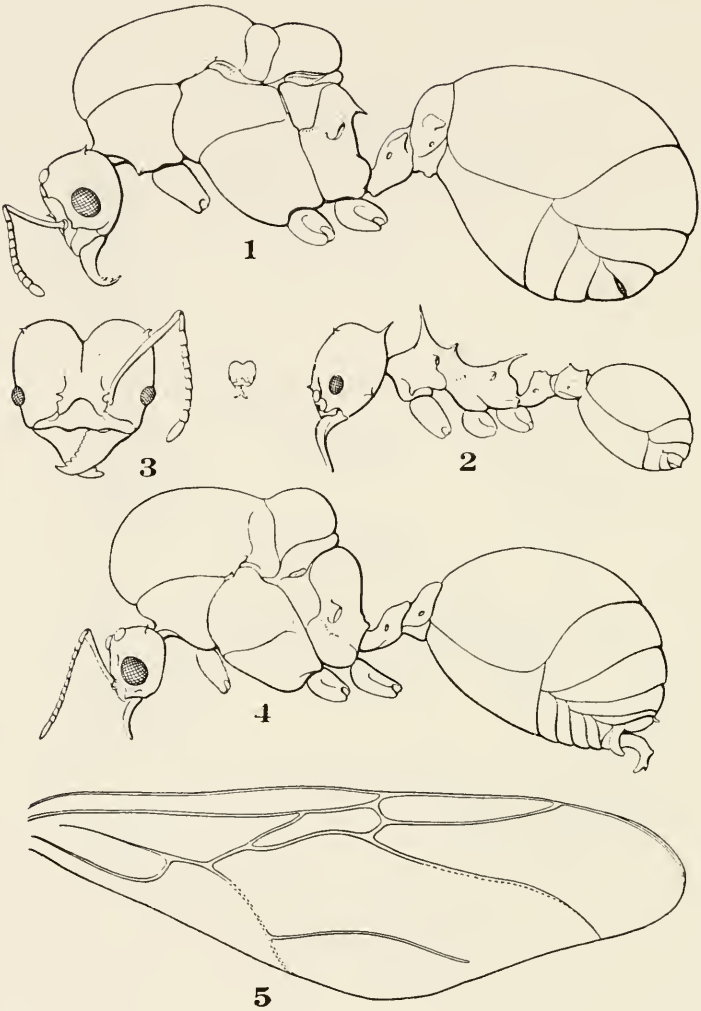


PLATE 42

Atta texana Buckley

1. Female. 2. Major worker. 3. Head of major worker with head of minor at right. 4. Male. 5. Wing.

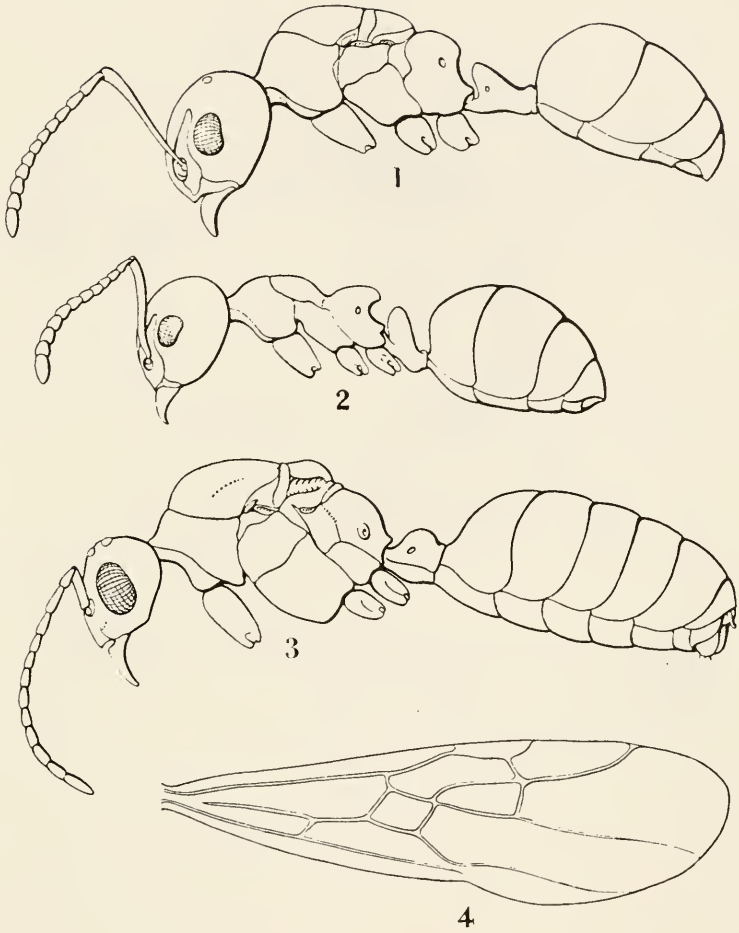


PLATE 43

Dolichoderus (*Hypoclinea*) *mariae* Forel

1. Female. 2. Worker. 3. Male. 4. Wing.

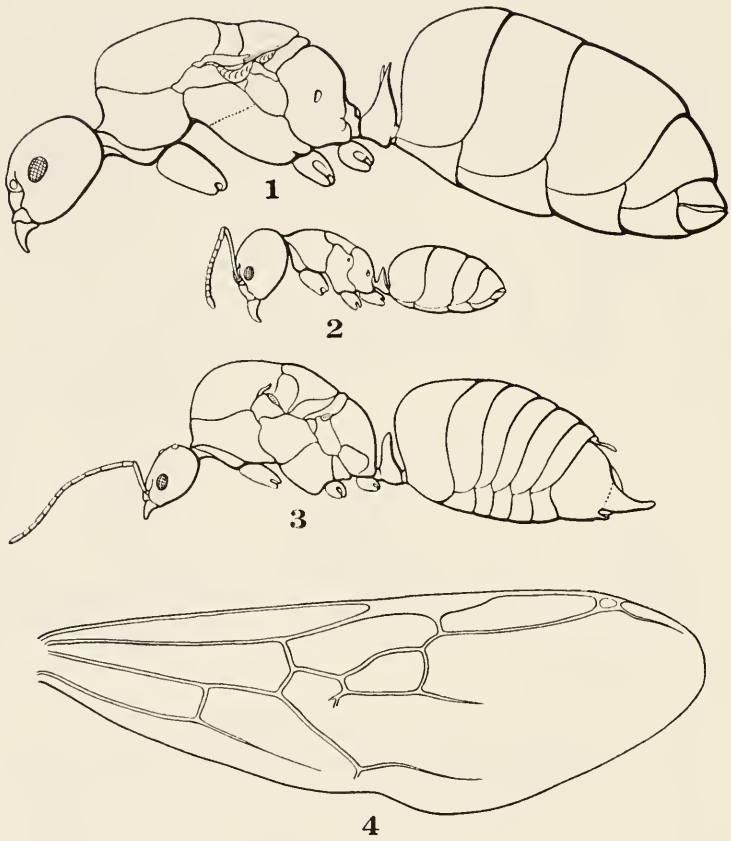


PLATE 44

Liometopum apiculatum Mayr

1. Female. 2. Worker. 3. Male. 4. Wing.

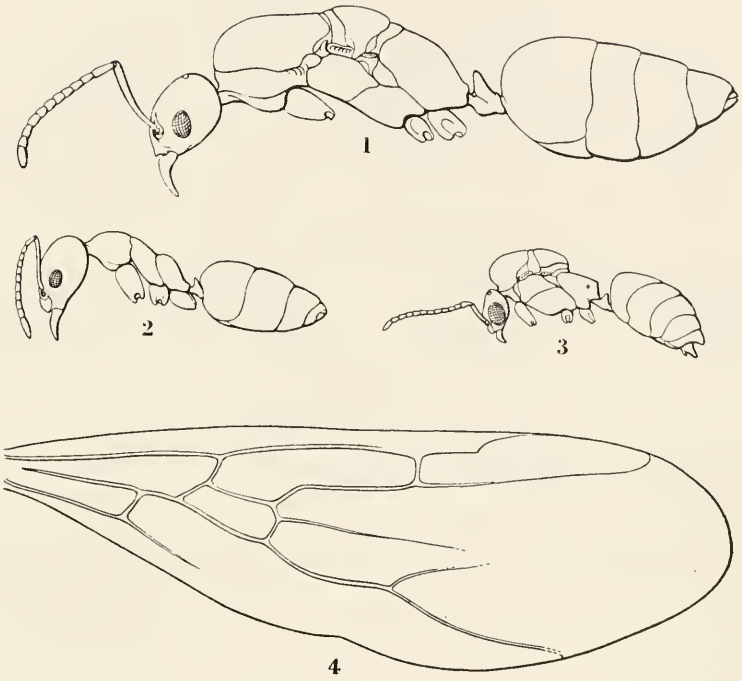


PLATE 45

Iridomyrmex pruinosum subsp. *analis* E. Andrè

1. Female. 2. Worker. 3. Male. 4. Wing.

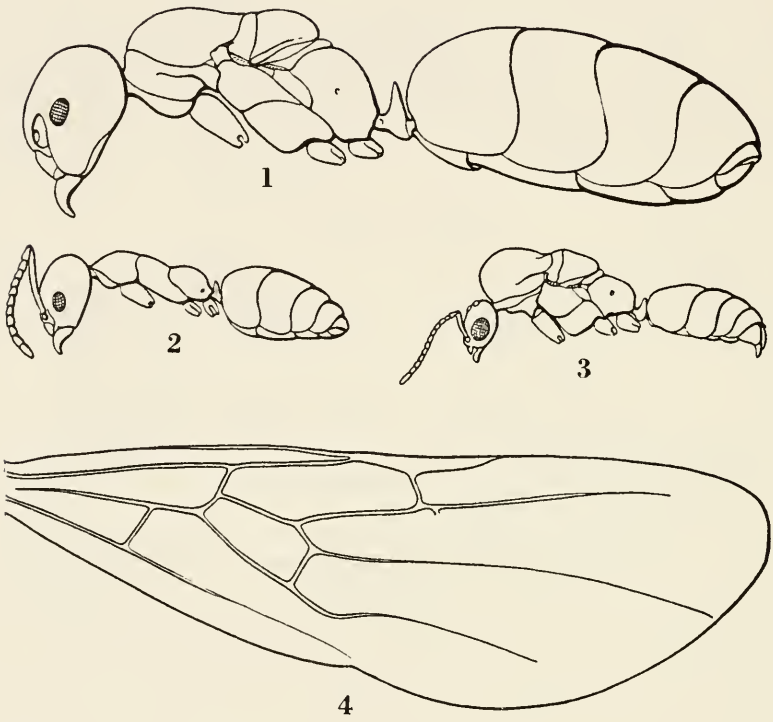


PLATE 46

Forelius foetida Buckley

1. Female. 2. Worker. 3. Male. 4. Wing.

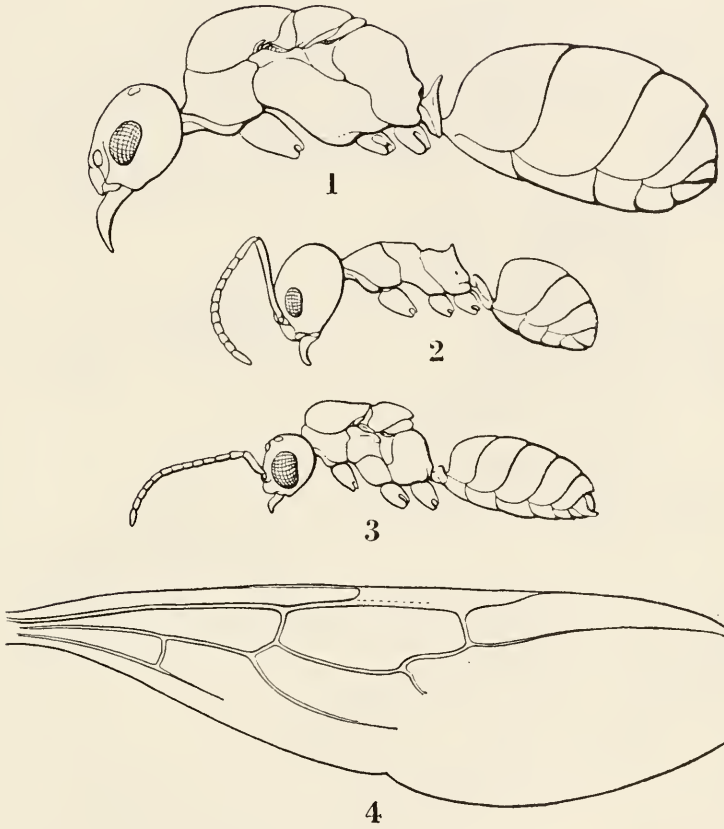


PLATE 47

Dorymyrmex pyramicus Roger

1. Female. 2. Worker. 3. Male. 4. Wing.

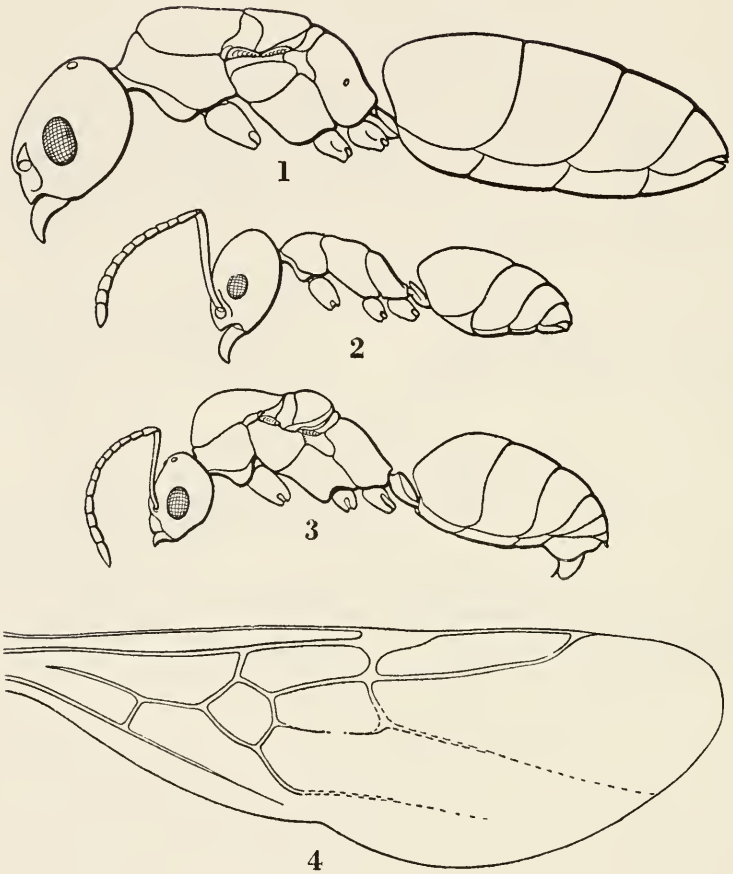
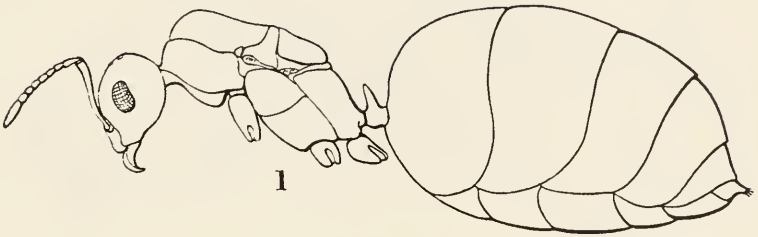


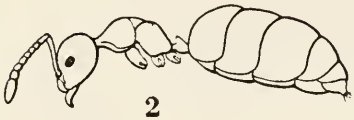
PLATE 48

Tapinoma sessile Say

1. Female. 2. Worker. 3. Male. 4. Wing.

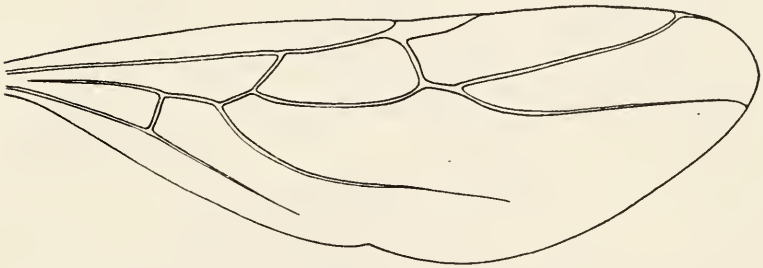


1



2

3



4

PLATE 49

Brachymyrmex depilis Emery

1. Female. 2. Worker. 3. Male. 4. Wing.

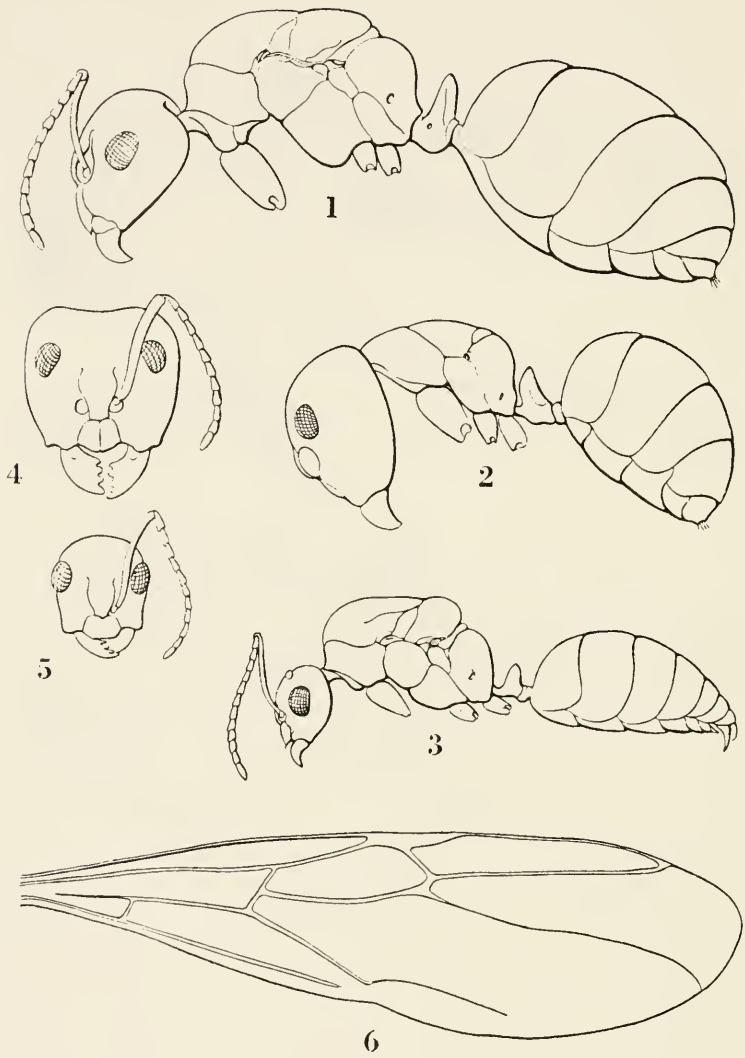


PLATE 50

Camponotus (*Tanaemyrmex*) *sansabeanus* Buckley

1. Female. 2. Worker. 3. Male. 4. Head of major, full face. 5. Head of minor, full face. 6. Wing.

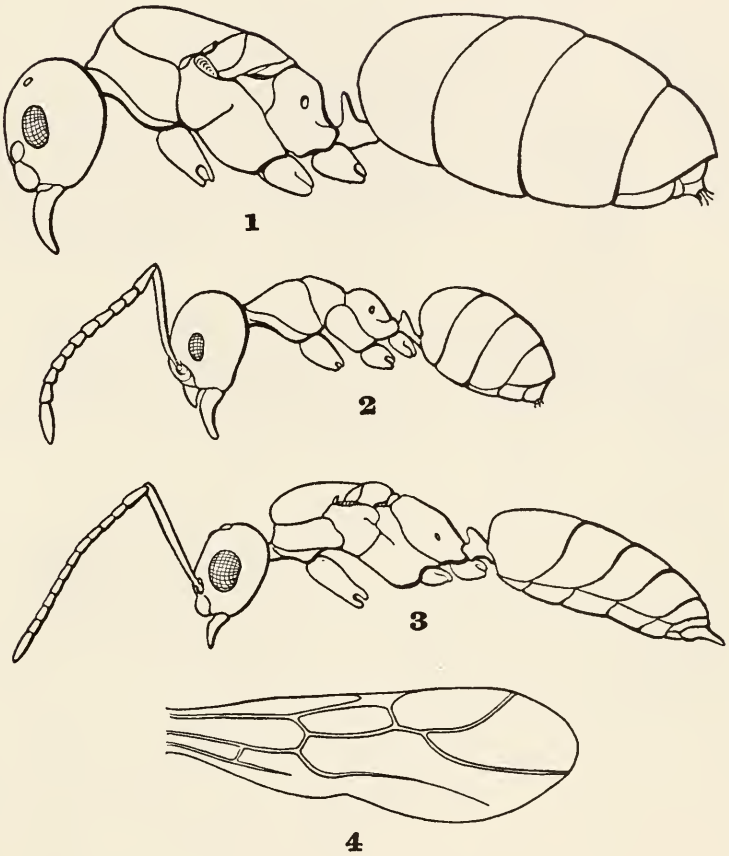


PLATE 51

Paratrechina (*Nylanderia*) *bruesi* Wheeler

1. Female. 2. Worker. 3. Male. 4. Wing.

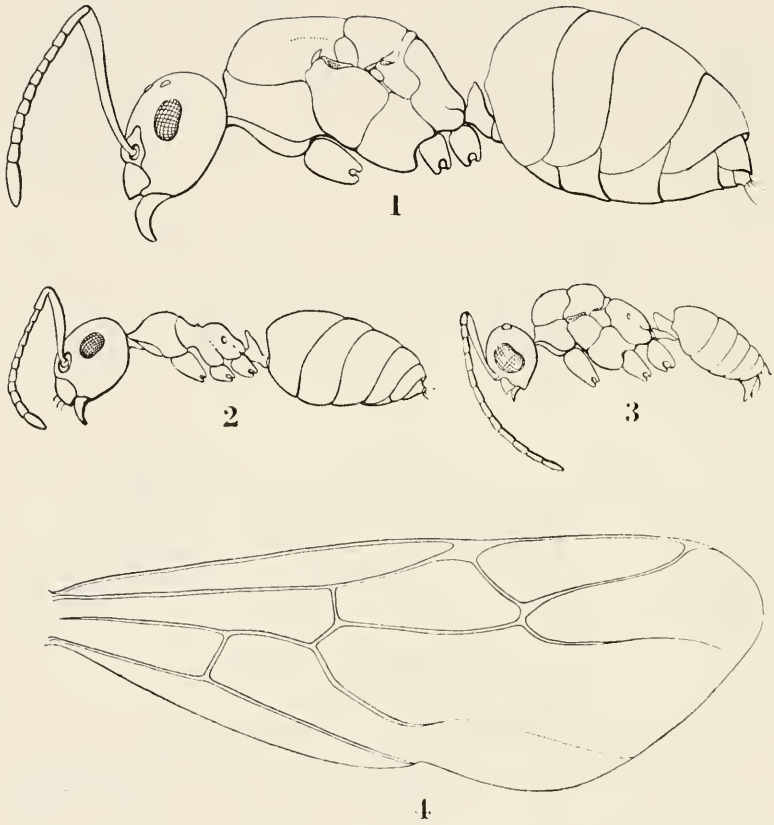


PLATE 52

Prenolepis imparis Say

1. Female. 2. Worker. 3. Male, subsp. *californica* Wheeler. 4. Wing.

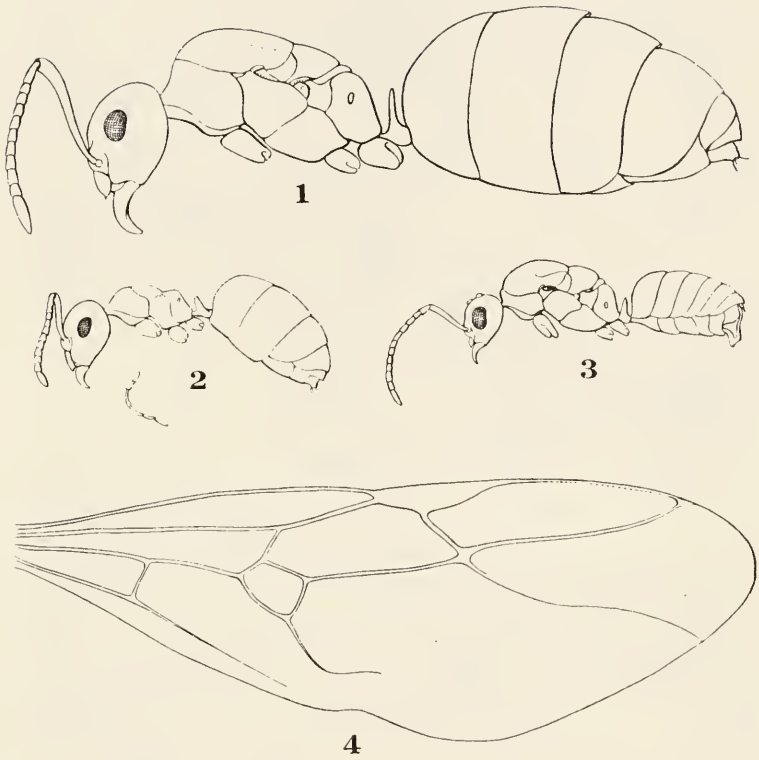


PLATE 53

Lasius alienus subsp. *americanus* Emery

1. Female. 2. Worker and maxillary palp. 3. Male. 4. Wing.

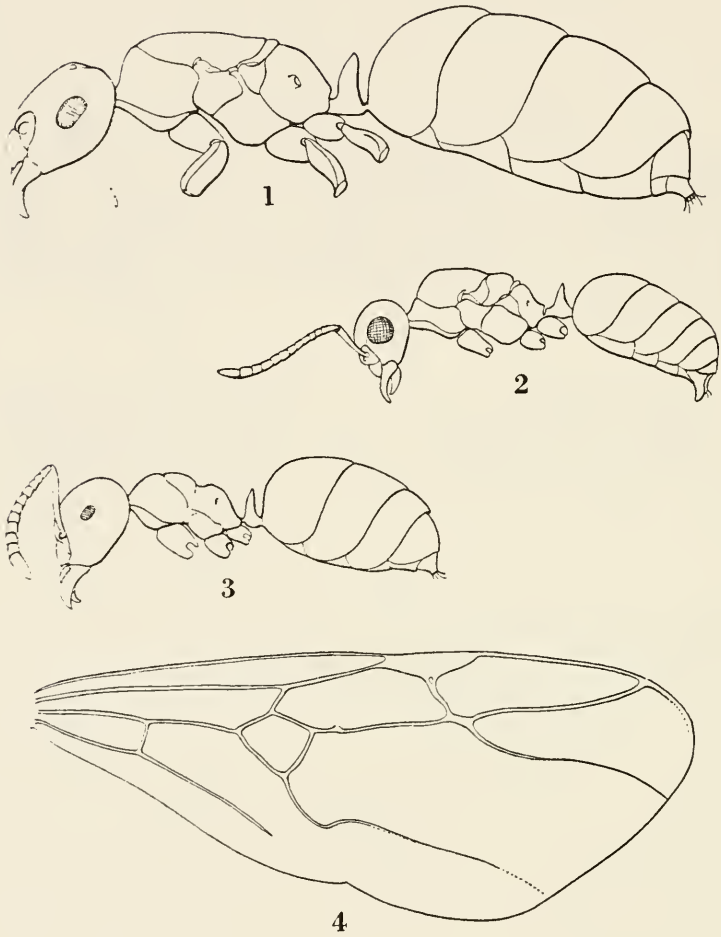


PLATE 54

Acanthomyops occidentalis Wheeler

1. Female and maxillary palp. 2. Male. 3. Worker. 4. Wing.

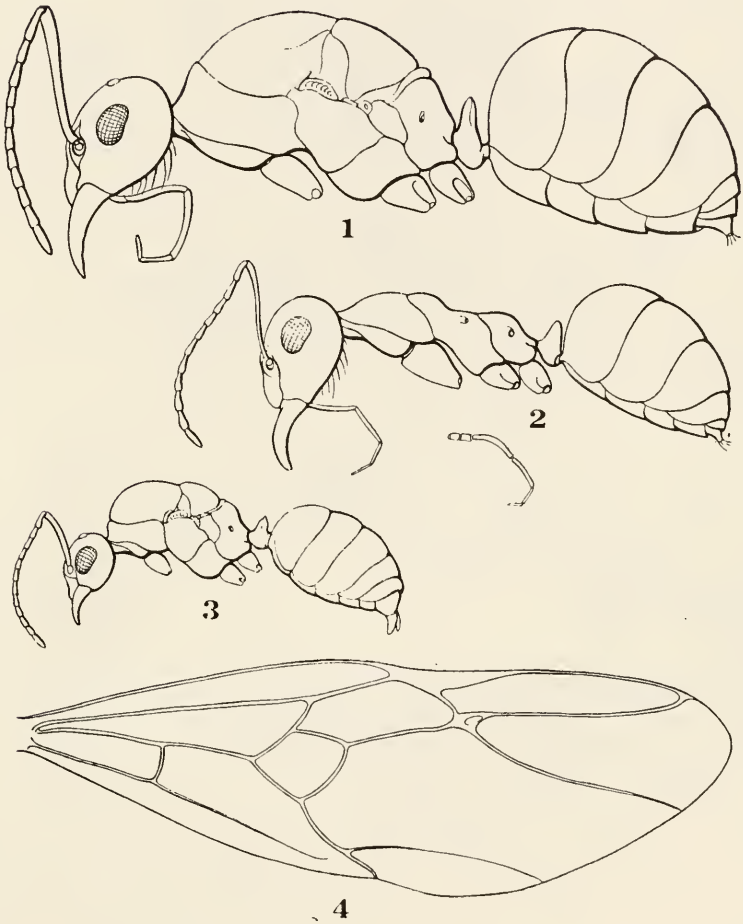


PLATE 55

Myrmecocystus mexicanus subsp. *hortideorum* McCook

1. Female. 2. Worker and maxillary palp. 3. Male. 4. Wing.

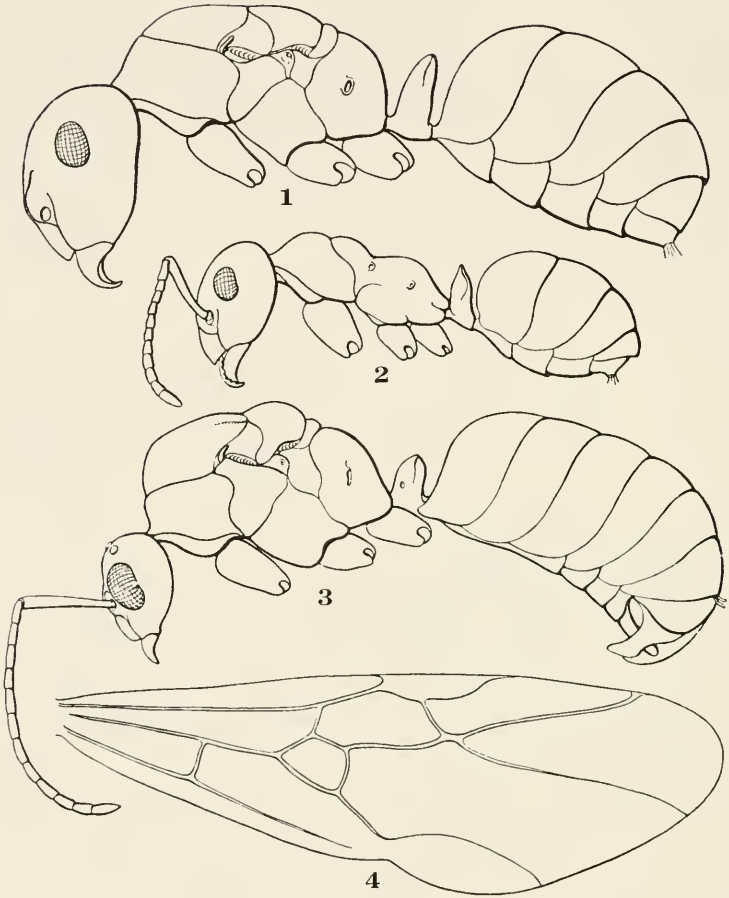


PLATE 56

Formica (*Raptiformica*) *rubicunda* Emery

1. Female. 2. Worker. 3. Male. 4. Wing.

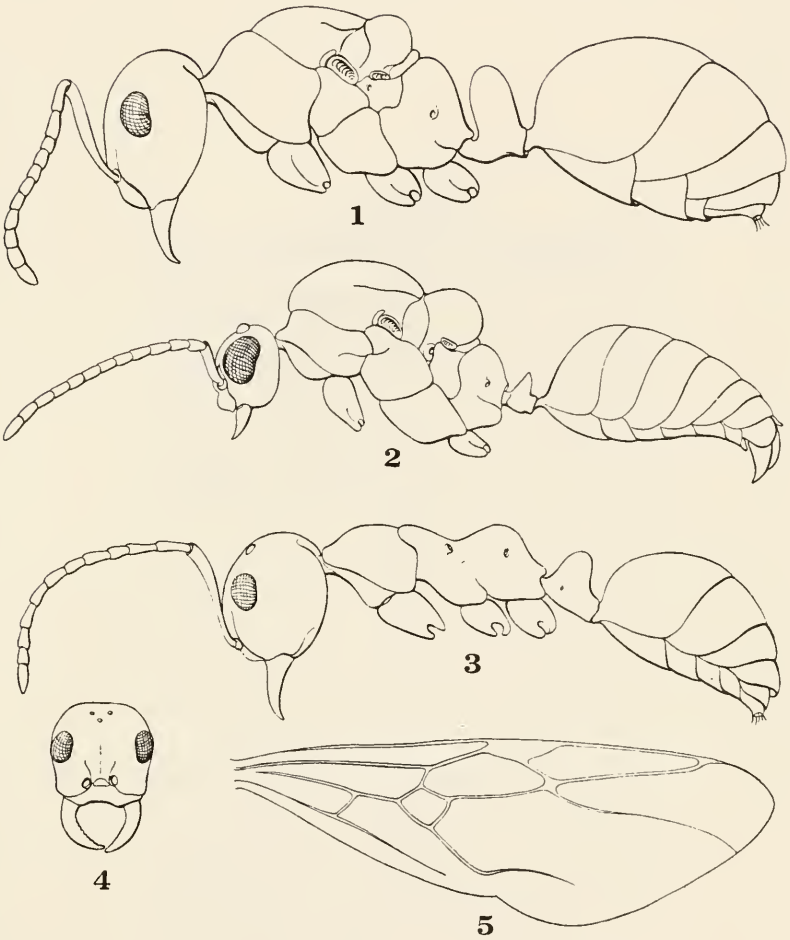


PLATE 57

Polyergus lucidus Mayr

1. Female. 2. Male. 3. Worker. 4. Head of worker, full face. 5. Wing.

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